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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

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BRITISH INEMATOGRAPHY

e Journal of the British Kinematograph Society

UME SIXTEEN, No. 1 JANUARY, 1950

MESSAGE FROM THE PRESIDENT

Dear Member,

In this, the first issue of "British Kinematography" for 1950. I want to take the opportunity of thanking you for the support you have given the Society in the past.

Founded in 1931, our Society can, during its nineteen years' existence, claim achievements which have been a cause for pride among those who have taken an active interest in its welfare ; but nevertheless there is still ample scope for each one of us to increase the usefulness of the Society by making its aims more widely known among our business associates.

Broadly speaking the Society's terms of reference are those of providing a focal point for the collection, re-distribution and discussion of all technical matters relating to kinematography, and under the aegis of its Council and its specialised Divisions and committees it affords facilities for the promulgation of scientific data, for the interchange of news among technical experts, for the standardisation of equipment and processes, and for that liaison with kindred Societies and Industries which is so necessary to the progress of all concerned.

With a view to increasing the effectiveness of the Society's work a new secretary, with outstanding qualifications, has been appointed. Miss Joan Poynton, who assumed that position on January 2nd., brings to the Society eighteen years of secretarial experience, in the commercial, social and public health fields.

I am confident that Miss Poynton will receive the assistance and co operation of every member. May I hope that during the year you will use your best endeavours to further the aims of the Society, by supporting its activities, and particularly by introducing new members.

With my best wishes for a happy and prosperous 1950.

Yours sincerely,

A W Watkins

President.

A SMALL CONTINUOUS PROCESSING MACHINE FOR EXPERIMENTAL WORK.

G. I. P. Levenson, Ph.D., B.Sc., M.B.K.S. *

Read to the British Kinematograph Society on October 5, 1949.
Communication No. 1307H from the Kodak Research Laboratory.

IN many motion picture processing laboratories continuous processing machines are still referred to by the older operatives as " the automatics," thus indicating that it is not so many years since the continuous processing machine became generally used in place of rack-and-tank systems in the sphere of large scale production. Continuous processing machines have undergone a considerable degree of evolutionary change in two decades, from the early 20 feet-per-minute types that were generally used in large numbers to achieve large output, to the latest, tendency-driven spray processing machines that run at speeds in the region of 300 feet per minute.

At the time of presenting this paper almost all the continuous processing machines that were ever installed in this country are still in operation, the war having retarded the replacement of the oldest machines. Several of the larger laboratories are now on the point of renewing their plant, and the older machines will disappear in the next few years.

Need for Experimental Machine

However, all 35 mm. continuous processing machines, of whatever vintage, are highly specialised mechanisms that are ill-adapted without major alteration to perform any function other than that for which they were originally intended ; and for efficient use they must be continuously at work processing film at a constant (nearly maximum) speed and within a narrow range of processing conditions. The truth of this observation will become readily apparent to the nonconformist who approaches the commercial laboratories with, say, 500 feet of negative film that he would like to have developed to a gamma value of 1.0 instead of the usual 0.65. If, moreover, he wanted to have it developed in something other than a D.76-type bath, for example, an Elon-pyro developer, his chances of having the work undertaken would become insignificantly small.

The laboratory manager who wants to conduct experiments on processing conditions is at almost the same disadvantage as the customer in this respect, because such experiments would usually involve a considerable loss of normal output ; they might well upset a bath that is nicely under control for the normal work, or worse, they may require such a bath to be discarded.

The machine that is the subject of this paper was constructed primarily to facilitate experimental work on the processing of motion picture film, and it has proved its worth over a period of several years. It has been the subject of considerable interest among workers in various kinematographic fields, and this interest has encouraged the present publication of the details of its general principles and of its construction.

General Principles

The machine was designed to be able to deal with the widest possible range of continuous processing problems. For the purposes of motion picture technical service we required a machine on which we could study negative and reversal processing, intensifying, reducing, hypersensitising, washing, squeegeeing, drying, cleaning, polishing, etc., of any film of 35 mm. or less, in width, perforated or otherwise. The machine was also wanted to handle other materials such as paper or metal foil strip, and, in effect, any material that required

* Research Laboratories, Kodak Ltd., Wealdstone, Middx.

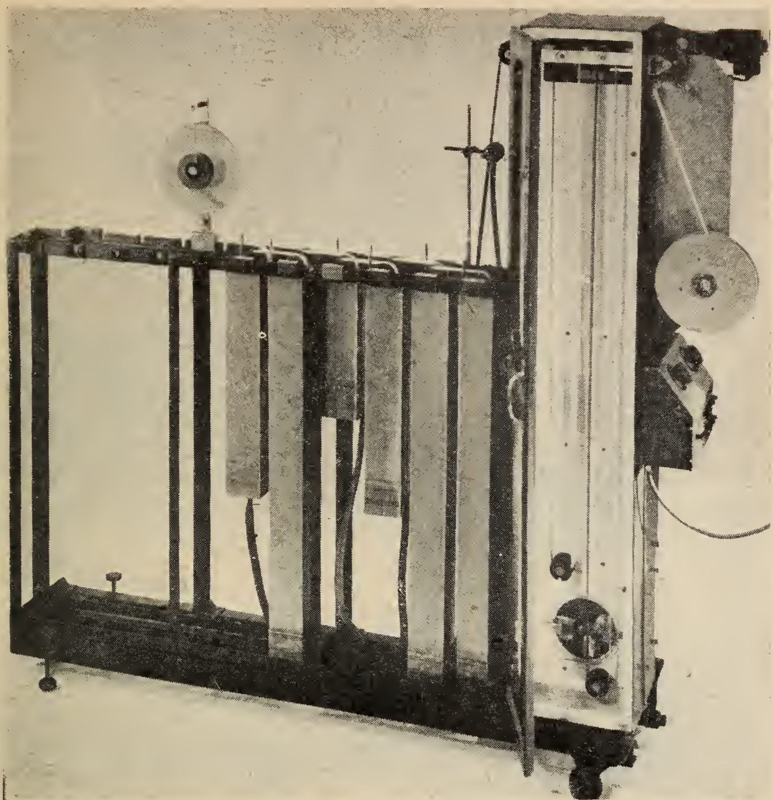

Fig. 1. General view of machine

continuous treatment and which was sufficiently flexible and tenuous in strips of 35 mm. or less in width.

For the purpose of continuous processing machine design we wanted a pilot machine which could be used to specify the times of the separate operations before designing the prototype machine. For studying the chemistry of exhaustion and replenishment it was necessary to have tanks of small capacity and, in order to obtain long processing times when necessary in such small tanks, to have a range of speeds diminishing to about 3 inches per minute.

It was clear that no one machine could economically cope with such a wide range of functions. Therefore, instead of designing a machine, a collection of loose, interchangeable parts was designed so that any sort of processing machine could be assembled in a short time. Hence our so-called " machine " is really a sort of constructor's kit of continuous processing machine parts. A typical assembly of parts is seen in Fig. 1.

In order to achieve maximum flexibility of arrangement, and to cheapen the construction, no driving effort was provided at any point in the wet end of the machine. The film is pulled through the tank assemblies by the drying unit. Since the tension in the film due to bearing friction increases by geometric progression each time the film passes round a bobbin, the friction is minimised by using ball bearings on all the non-immersed spindles.

The Main Frame

Provision is made to accommodate a maximum of eleven tanks because this number is sufficient for black-and-white reversal processing and, moreover, this proved to be the maximum number that the film could be pulled through (using the drying cabinet shown) without the film tension at the driving wheel exceeding about one pound.

The basic structure on which all the various machines can be assembled is a stout steel chassis, mounted on casters, and carrying a manifold drain pipe. On part of the chassis is a frame-work of small section steel angle which serves as a rack on which the solution tanks can be suspended. The tank-rack is divided into eleven positions by sockets in the top horizontal members which hold the ball races that are the bearings for the top roller assemblies (Fig. 2).

The Tanks

The tanks are all made to a uniform pattern except in respect of length. They are all of FMB stainless steel, of square 4″×4″ section, and fitted with a stout flange round the top edge so that they can be suspended from the tank-rack (Fig. 3). We have six full depth (43 ins.) tanks with a working capacity of 11 litres, four half depth tanks (6 litres) and two one-third depth (3½ litres).

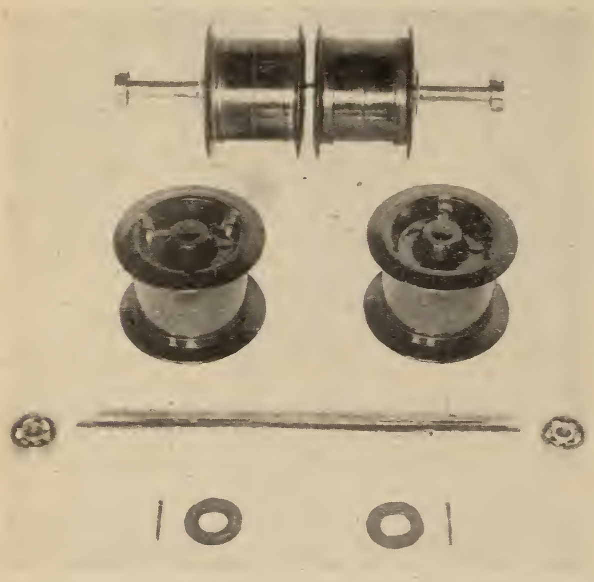

Fig. 2. Top roller assembly. The Bakelite rollers were made by screwing together two single-sided 17.5 mm. rollers that happened to be available

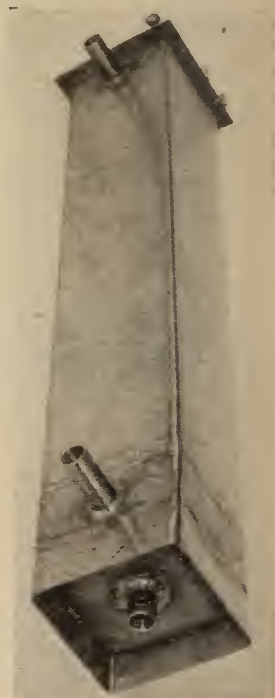

Fig. 3. View of one of the standard tanks showing the three hose connections and the recessed bottom that allows the tank to stand on the floor when not required

Three hose connections are provided in each tank to allow the circulation and agitation of the solutions in a number of ways, to provide a drain connection to one of the eleven points on the drain manifold, and to allow tanks to be inter-connected. A few of the methods of achieving these objects are indicated in Fig. 6. Rubber tubing is used for the connections. After completing an assembly of tanks and connecting them to the water supply, to each other, to the drain manifold, etc., all unwanted hose connections are closed with rubber bungs.

Film Path

To return to the film transport : one loop of film is formed in each tank, the submerged roller (Fig. 4) being carried on the end of a channelled rod, which may be lowered to any depth, and is set over at an angle to fit best into the bottom of the loop of film. Since the direction of this angle depends on whether a given tank is to be used in an " odd " or " even " position in the assembly (counting from the drying cabinet end), there is an alternative socket to hold the supporting rod. This alternate positioning of the lower roller supporting rod is evident in Fig. 1.

It is important that, on the wet side at least, the film is not threaded through any closed circuits that do not allow it to be removed sideways, so that tanks, etc., can be removed without requiring the machine to be re-threaded. It will be seen that if two adjacent tanks are removed from the system the two loops then unravel to give a straight untwisted strand. This factor facilitates threading up ; and if experiments are being carried out which require the removal or addition of a treatment, the tank assembly is so arranged that two adjacent tanks are affected, thus making it convenient for the film to pass through them in two loops or over them as a straight strand.

If the machine is to operate, as ours is, in an air-conditioned building, very

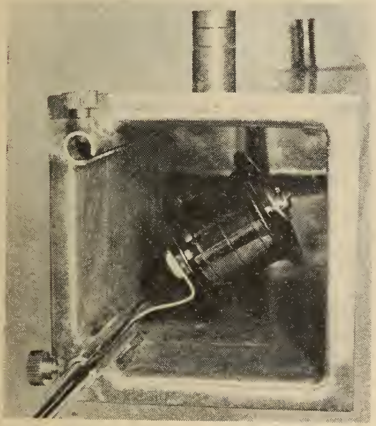

Fig. 4. Top view of one of the standard tanks showing the method of holding the immersed roller. On the underside of this roller is a guard strip that prevents the film from falling away and becoming de-railed in case of a slack loop

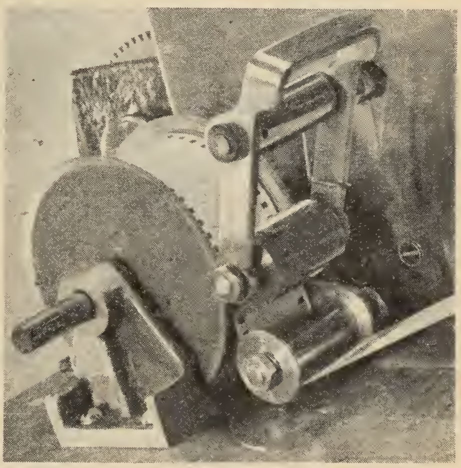

Fig. 5. The pull-off roller

little need be done to achieve temperature stability at the room temperature. Experience has shown that air-agitation of the solutions is very effective in producing uniform results and produces very little change in the performance of developers as the result of autoxidation in a day's work. Because of the small capacity of the tanks we have made no attempt to save developer from day to day, preferring to use fresh for each day's work.

Squeegeeing

A vertical rod is attached to the tank-rack at the drying end and various types of film wiping devices can be fixed here using ordinary laboratory clamps. As part of the kit we have an air-squeegee, a suction box and a rubber finger squeegee.

The air-squeegee is usually used because we have compressed air laid on as a factory service. However, our experience indicates that, when power is limited, the most efficient way of completely removing the supernatant water from 35 mm. film moving at speeds up to the machine's present maximum of 15 feet per minute, is by suction. It requires about 2 h.p. to blow the film clear of water, but only 0.1 h.p. to suck it off.

The Drying Cabinet

The machine can be set up with any type of drying device :— a cabinet with warm air or radiant heat, a drum with hot air or radiant heat, etc., provided only that the drying unit supplies the effort for pulling the film through the tanks. So far, we have only required the warm-air cabinet that is shown in the illustrations. In order to conserve heating power, the air can be entirely or partly recirculated, depending on the rate at which water is carried into the cabinet.

The fan, of variable speed, draws the air through the heater mats (six 360-watt units), and pushes it into the drying compartment. The air rises through the drying compartment and returns down the back of the cabinet. The setting of the inlet and outlet louvres, and of the damper, control the proportion of the air that is recirculated. The lengths of the loops in the drying cabinet can be varied.

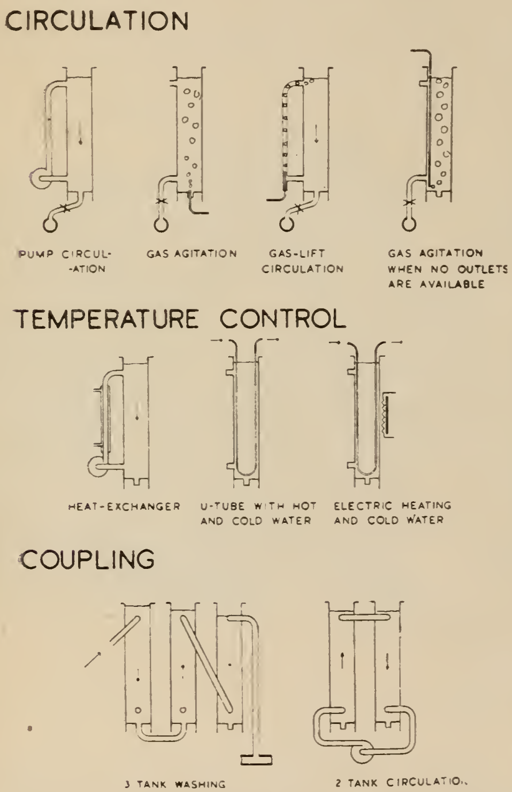

Fig. 6. Some typical methods of achieving circulation, agitation, and temperature control

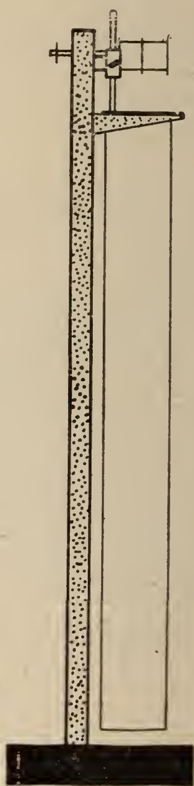

Fig. 7. Modified form of tank rack suggested for future machines

Film Drive

The film drive on the existing cabinet is obtained by wrapping the film about two-thirds of the way round a hard rubber roller and nipping it with a spring-loaded pressure roller (Fig. 5). Two ranges of film speeds, 3 ins. to 5 ft. per min., and 5 ins. to 15 ft. per min., are obtained by a gear change, and variation

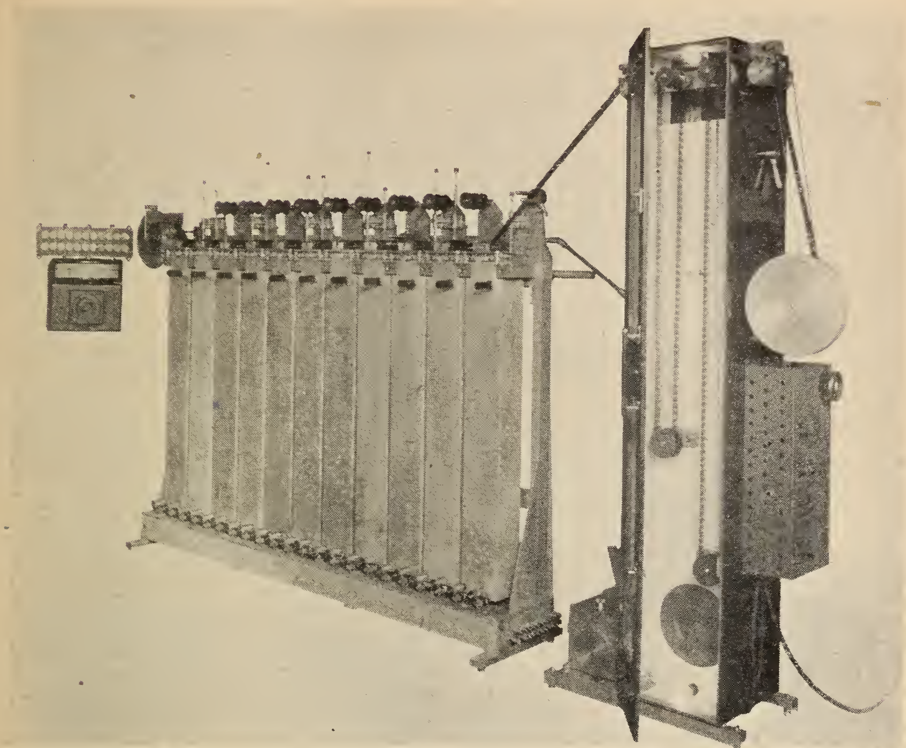

Fig. 8. Machine built on the lines illustrated in Fig. 7 by Weyers Bros., for British Lion Studios. Each tank is water-jacketed and thermostatically controlled. The Negretti and Zambra control unit is shown inset. The drying cabinet is separate from the wet end so that it can be installed in an adjoining light room.

of the speed within the ranges is achieved by a resistor in the motor circuit. The rewind is driven by a leather belt and slipping clutch, and has a set of hubs to accommodate the various widths of film.

Splices in the film are made by binding the ends together with adhesive tape. This gives a flat, flexible splice that will pass round the rubber driving roller without causing any damage. Because there are no sprockets in the machine, and the film is pulled through, it is possible to splice 16 mm. film to 35 mm. film and process them consecutively, assuming that they both require the same treatment.

Conclusion

Experience with our present machine has shown it to be of considerable usefulness in tackling a number of jobs requiring continuous treatment, ranging from ordinary motion picture processing, to the application of solvent to remove scratches from projected film. However, in the light of experience gained with the present machine, certain modifications are suggested that would seem likely to improve the apparatus without greatly detracting from its chief virtue of simplicity and adaptability.

It is suggested that the present style of rack for holding the tanks should be modified to a back frame with short projecting arms on which each tank could be suspended. This would enable any given tank to be removed without having to disturb and empty any of the others (Fig. 7). The holders for the elevator rods should be mounted on the back frame. To assist in the transport of the film it is probably worthwhile, especially when a large number of tanks are to be used, to have driven rollers over each tank position, and the final pull-off roller should then be slightly overdriven through a clutch so as to maintain a slight tension in the film.

Fig. 8 shows a considerably refined machine built, for special effects work, along these modified lines by Weyers Bros. Ltd., to the specification of Mr. W. Percy Day of British Lion Studios. In this machine each tank is water-jacketed and thermostatically controlled and the air agitation system is built in. The author is indebted to Messrs. Weyers and Mr. Day for permission to refer to their machine.

DISCUSSION

Mr. J. G. Craig: Could Dr. Levenson give us some idea of the probable cost of this machine?

The Author: The cost depends on how you propose to build it. You could build it yourself for perhaps a few hundred pounds; if you have the machine constructed by an outside firm, it would cost considerably more.

Mr. Langley: If one built the chassis of this machine, and wanted to cover every type of black-and-white processing—what is the minimum number of tanks required? I am thinking of the possibility of using the one chassis for developing negative, positive and duplicating stocks, as the occasion arises.

The Author: First it depends upon the output you require. If the time is not important, then you would want about three tanks for washing, two for fixing, and then you would want about two for each developer, if you wanted to have more than one developer ready in a tank. It has been suggested to make a developing tank another 1½ in. or 2 ins. each way in section larger so that we could put four loops into the tank—two sets of three bobbins above and two sets of two bobbins at the bottom of the tank. This would serve for positive developing, and another for negative, and a fixing tank on the same lines. With the same assembly of loops, but with separate washing, you have a machine with four tanks.

Mr. Honri: Is it similar to the plant that is installed at M.G.M. British studios?

The Author: No, that is a separate processing machine—much bigger, and a more permanent apparatus than this.

Mr. B. Honri: It seems to me it is something more than an experimental apparatus. I would say it is a developing plant capable of dealing with negative development outside the range of the normal commercial processing machines.

Mr. R. H. Cricks: Are you able to use spray development, as in the M.G.M. machine?

The Author: One could, by means of a separate developing tank. We have used the machine for such diverse work as processing film, taking out scratches, cleaning film, and not so much for continuous work.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library

THE PRACTICAL APPLICATION OF ACOUSTIC PRINCIPLES. D. J. W. Cullum. E. & F. N. Spon Ltd., 16s. 200 pp.

This is one of the Architectural and Building Series, published principally for the architectural profession. The clear and simple explanations of the many problems of sound, both wanted and unwanted, make it, however, very useful reading for many members of the kinema industry and not only those connected directly with sound recording or reproduction.

Many useful reference tables and graphs are given, although one notes with regret that the only table of absorption coefficients included is a reprint from 1942, in spite of the work done by the Sound Insulation and Acoustics Committee of which Mr. Cullum is a member. It must, however, be appreciated that in a book covering so wide a subject certain matters must inevitably be incompletely covered.

The author is in agreement with the advice so often given relative to entering into litigation; according to his penultimate chapter the answer would appear to be "Don't do it!"

Geo. E. Burgess.

PAINTING WITH LIGHT, by John Alton.

John Alton presents an authoritative book on lighting with a wealth of interesting illustrations. Photographers, both amateur and professional, should find a great deal of valuable information here which has the merit of being up to date.

My criticism, if any, is that Mr. Alton has tried to cram too much into too little space, sacrificing important details of photographic lighting, and floundering a little out of his depth in romantic theories which seem rather out of place in an otherwise intensely interesting book, which could only have been written by an experienced director of photography.

F. A. Young.

THE FILM IN RELATION TO AGRICULTURAL ENGINEERING

Douglas Hardy*

Read to the B.K.S. Sub-standard Film Division on October 12th, 1949.

DURING the last six years the number of agricultural tractors in use in England and Wales has more than doubled itself, with a proportionate increase in the still growing range of powered implements which have become a necessity to the present day systems of mechanised farming. As the machinery requirements of the farmer increased, so all branches of the agricultural engineering industry rose to fulfil his demands. The manufacturer has stepped up his output ; agricultural education has been extended to give more emphasis to mechanization and much research and development work has been done, in some cases by the larger manufacturers, and particularly by the National Institute of Agricultural Engineering.

As the older machines and methods of production have been superseded by more modern ideas, science has stepped in with its many aids, and among the more important of these has been the 16 mm. film. All phases of the industry have realised the value of the film in its many forms. The instructional film has been used by both farmers and students alike. Advertising films have also played a part in the publicity of the larger firms, but particularly has there been a great demand for the film by the research and development sections of the industry.

Origin of the Institute

Since most of these applications are included in the work of the N.I.A.E., it will be helpful to give a brief outline of the work of this organisation. Before the war the Institute's predecessor—the Department for Research in Agricultural Engineering—was a small part of Oxford University staffed by a handful of agriculturalists and engineers. Its chief photographic activity was confined to an odd " still " on a Super Ikonta. As the industry expanded at the outbreak of war, the nation's demands on the Institute became greater until, in 1942, the Ministry of Agriculture set up a National Institute at Askham Bryan, near York, with a larger staff, and facilities for developing machinery and assisting manufacturers—testing out new implements—evolving new field techniques and training machinery instructors who were to be attached to the various County War Agricultural Executive Committees.

The Institute's first use of the film was in training these machinery instructors. Confronted with the problem of giving them a six weeks course to begin in the middle of January, it was decided to make films to illustrate operations and machines which it would otherwise have been impracticable to demonstrate at that time of year. This was done at about two months' notice, and the films proved extremely useful. Since then the N.I.A.E. has grown and made much more use of the film and still photography. Although the latter is used almost exclusively for record work the film has been more fully exploited, and can be divided roughly into four main categories :

1. The instructional films which have already been mentioned. These were originally intended for internal use in the Institute, but as the Government's educational policy was extended the County Machinery Instructors were equipped with copies to help in their lecturing duties. Many of the agricultural colleges were also supplied with this type of film.

2. Record films have been made to record the performance of machines which are often dismantled after trials.

*National Institute of Agricultural Engineering.

3. Research films have been made to assist the research sections in their investigations.

4. One of the duties of the film section has been to keep in touch with the film world generally and arrange for the showing of films which are of special interest to any departments of the Institute.

These are briefly the main film activities of the N.I.A.E., although a great deal can be said on each individual section.

The Instructional Film

Putting revolutionary ideas into the farmer's mind was a formidable undertaking. For generations the farming community had thought in terms of horses and simple horse-driven implements, and to educate the farmer to think on the lines of mechanisation as soon as humanly possible, was a task which made the machinery instructors look to all the available resources. The films which had been made to train the M.Is. were released for general use and more films were made.

The first major decision which had to be faced was the old controversy of sound *versus* silent. The films were intended to be used as aids to a lecturer rather than self-explanatory lessons in themselves, and it was considered preferable to make the films silent so that the lecturer could alter the commentary to suit his particular audience. Agriculture above all subjects varies greatly according to localities ; the West Country farmer and his counterpart in, say, Durham or Northumberland have completely different names for the same implement, and it was a great help for the Instructor to speak to the farmer in his own local terms. This was particularly useful, in fact essential, in some of the more remote parts of Scotland and Wales. The instructor's work was not limited to showing films, he had to be an all-round man capable of doing lecturing and demonstration work in the field, and the fact that he could commentate on his films helped to give the farmer confidence in his ability, and was always much more conducive to discussion than sound film would have been. Although the training course which these instructors underwent was devoted primarily to a study of farm machinery, the film was considered such an important part of their equipment that the course always included special instruction in the use, care and maintenance of films and projectors.

Films were shown under all manner of conditions. Many of the areas served were miles from electric mains and so battery projectors had to be used. Ingenious back-projection units were devised, some of them mobile, others constructed inside marquees at agricultural shows.

Special Techniques

Most of the films dealt with straightforward field activities and techniques, such as the correct way to set a tractor plough, or the use and maintenance of a combine harvester—an expensive machine which was a new project to the majority of farmers and needed carefully explaining before the best results could be obtained. Some films, however, required special techniques. One example of this was the film " Systematic Ploughing " which demonstrated the way of setting out and ploughing a field, using the minimum amount of time and fuel—the latter consideration being of the utmost importance during the war. To film a tractor ploughing a 3-acre plot would take a day to demonstrate on the screen, and so it was decided to make use of the time-lapse technique to speed up the whole operation. This meant that the tractor which normally runs at about 2 or 3 m.p.h. was filmed at 1 frame per second, and appeared to move round the field at about 40 or 50 m.p.h. The result was that a full day's ploughing was shown to the audience in 30 minutes, and, although the first impression was rather comical, the audience soon settled down to it seriously and the lesson was taken very much to heart. In order to counteract the outbursts of mirth a small trailer was made to introduce the main film and thus prepare the audience for the race track performance.

Some difficulty was experienced in finding a site for photographing this film, with a view-point high enough to command a bird's-eye view of the entire field which was to be used for the demonstration. Shooting continuously over a period of many hours, which were spread over a number of days in November, caused many headaches in changing light. One very distracting feature was the cloud shadows which also moved across the field at 16 times their normal speed. However, a reasonable result was obtained, and this unusual method of demonstrating a slow operation proved very successful and popular.

The binder knotter is a small and ingenious piece of mechanism which is not only a very common source of trouble to the farmer, but it also presents a problem to the instructor. This is partly because it is only a matter of inches

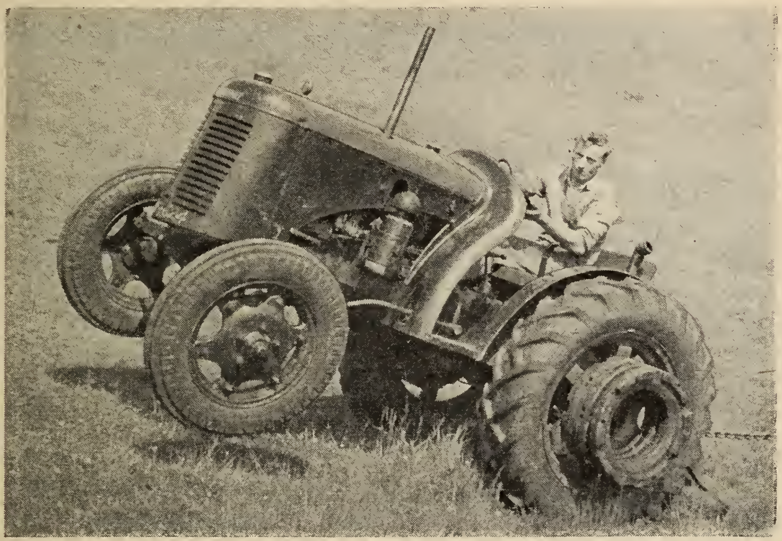

Fig. 1. Tractor rearing on a gradient.

in size and is therefore a difficult subject to demonstrate to a crowd of farmers. The chief snag, however, is the fact that, although troubles occur all too frequently in the field, it is usually very difficult in a demonstration to make the machine do the wrong thing at the right time. Much care and patience was required before all the faults and remedies had been successfully filmed. This film has now made it possible to project the 3-inch knotter on to a screen to be demonstrated with ease—and certainty—to a large audience.

The instructional film has not been limited to the use of County machinery advisors. Other instructional films were made with a broader application, being more of a documentary nature and designed to be shown to a much wider audience. Some of the more general of these found their way on to the theatre screen, while the more technical ones were used extensively by the C.O.I. mobile kinemas during the war. They were sound films and consequently produced on a grander scale at a higher cost.

Some of the larger manufacturing concerns are making use of films in their advisory services. The Shell—B.P. organisation for instance, now has its own Farm Service consisting of mobile lecture units equipped with 16mm. films, 35mm. film strips and various lecture charts. These units operate in rural areas taking the information to the farming audiences, and naturally emphasise the lubrication and fuel aspect of the subject. Full use is made of each type of visual aid. Where the subject can be explained more easily in motion, a sound film is shown ; where the still diagrams are preferred, film strips are used. The strip enables the lecturer to adapt the material to the audience whereas the sound film is less flexible. By illustrating a lecture with both strip and film alternatively as each is considered appropriate the lecturer can make the most of each type of visual aid. The two frame sizes are matched on the screen to minimise any distraction caused by the changeover. This system was planned as a sequence from the start, and blank cue frames have been purposely left in the film strip where the film is intended to be used. It should prove a very effective scheme.

So much for the instructional film and its wide and varied audience. It is shown from the village hall to the college lecture room and even finds its way into the workshop where some of the larger manufacturers are making good use of it to train their apprentices. This also serves to familiarize the factory workers with the practical value of the machines they have produced.

Record Films

In organisations such as the N.I.A.E., and the development sections of the larger manufacturers, machines are constantly being built as experimental models. More often than not they are afterwards dismantled, or at least extensively modified after trial. A few feet of motion picture film will provide an excellent record, not only of the details and construction of the machine but also of the performance. This enables later models to be compared side by side on the screen. One instance of record work has been a connection with the Institute's potato harvester development, which has spread over a number of years. Short records have been made at each stage so that there is now a complete film showing the evolution of the machine up to its present state.

Another of the Institute's functions is to work in co-operation with the farmer and manufacturer, to give advice and assistance on all matters concerning machinery. Such films as the " Potato Harvester Development " are a great advantage in explaining points to manufacturers, especially when they come for consultation in the off season. Many of the Institute's enquirers are from abroad ; frequently queries come from foreign visitors on such subjects as, say, British sugar-beet harvesters in the middle of July. The film section is in a position to show them a film of the exact machine in question in the comfort of the projection room, instead of walking over acres of muddy fields.

The Institute's film department has an " on call " service for making record films, and frequently receives very short notice to make such films—more often than not, having no alternative but to shoot in whatever conditions prevail. The time and place of filming is usually dictated by the machine and the conditions of work, and not by the cameraman.

Various difficulties are experienced in making this type of film. Slow-motion speeds are often used to show the movements properly. The cameraman often has to be perched in some precarious position on tractors and implements in order to obtain the correct angle. Soil and small plants are often difficult to distinguish in monochrome, and so considerable use has been made of colour film, although for black-and-white work the contrast between soil and plant can be sufficiently emphasized by spraying the soil with water and using a green filter.

The construction of a machine cannot always be shown to advantage when working in a field. Apart from having to contend with the inevitable layer of soil and mud, the lighting question often presents difficulties, especially when the important parts are right underneath the machines. For this reason record films are sometimes made in studio conditions where lighting and subject can be more easily handled. This was done last winter with a series of sugar beet harvesters. Some of these were foreign machines of unusual design. One was on loan and others were the only models in this country at the time and so considerable care was necessary to make a full record. In view of the complicated mechanisms and adverse weather conditions, filming in the studio was the obvious solution.

Films in Testing

The Institute often receives reports of new ideas and machines developed by farmers themselves. Since it is not always possible to have the machine at the Institute for a full trial, an officer is sent to report on the machine and a short record film is made. A visual reference can then be kept at the Institute and looked at whenever the subject comes up for consideration.

Apart from being used merely as a record of the machine, the film is often included as part of the test procedure. One of the Institute's services is to make full commercial or confidential tests at the request of manufacturers, who

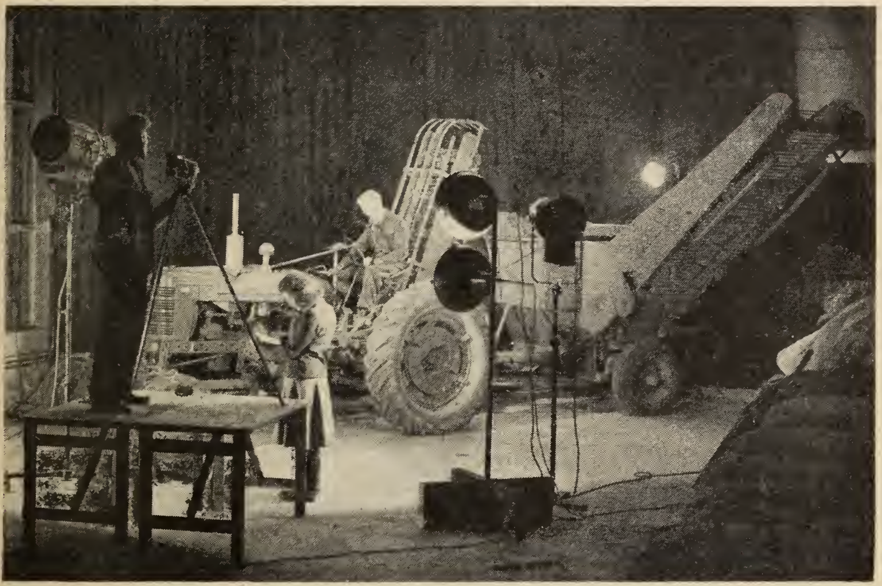

Fig. 2. Making a record film of a sugar-beet harvester. Although field shots are used to show the performance of the machine, soil, mud and bad light make it often difficult to show details of the mechanism.

ultimately receive a full scientific report of the machine's performance. This report includes details of any faults and suggestions for modifications. As it is not always possible for the manufacturer to be on the scene when trouble is experienced with his machine or when modifications are made, a film is taken in order to illustrate these points to him in later discussion.

One particular instance was that of a tractor which had been fitted with a special bracket to prevent rearing when working on steep gradients. The test section was called on to prove the efficiency of the device, and so, faced with every possibility of over-turning the tractor in the process, it was decided to keep a film record of each test run. Actually the tractor did overturn at one point, and although the critical moment was too brief for anyone to observe just what happened, the whole action was recorded in the camera. It was then possible to see exactly what had taken place, thus providing a record which was of value both to the Institute and the maker.

Notes are kept on record films, all of which are filed in the film library for reference. Many of these must naturally be treated in confidence. The remainder, in addition to their initial record value, are in constant demand to illustrate specialised lectures which are frequently given by members of the Institute staff. Occasionally they are borrowed by machinery lecturers at agricultural colleges, and copies are often purchased by the manufacturers concerned.

These films provide records which could not be expressed in any other form ; words or still photographs make a very inferior substitute. The greatest asset of a film library of this kind is the fact that, whereas a machine can only be seen working in the field one month out of twelve, it can be shown on the screen at any time. The combine harvester can be demonstrated in January and the seed drill in August. The film has overcome the seasons, in fact, if necessary, a lecturer can show a field being ploughed, sown and harvested within a few minutes.

Research Films

This aspect has developed as the Institute's research sections have increased. Much of this work is done at slow-motion speeds to allow movements to be analysed. Until recently speeds of 48 and 64 frames per second had been sufficiently rapid to study such things as the path taken by soil and potatoes as they leave the digging share or the action of tractor tyres under compression. As the development departments are now studying machines which work at much higher speeds, it has been decided to obtain a High Speed camera to explain the motion of such fast moving objects as thresher drums and pneumatic grain conveyors.

These films are made in conjunction with the research staff, and their results studied carefully, often frame by frame and even in reverse. As with record films, notes are kept and filed for reference. Every problem requires its own treatment. Sometimes it is necessary to compare the performance of two machines or components. The split-frame technique is an excellent way of doing this by showing both machines on the screen side by side. For measurement purposes a timing device is included in the picture. This was used recently in making a time and motion study of the movements of a hand-operated hoe when singling sugar-beet plants.

Trouble was experienced with a potato planter which for no apparent reason dropped potatoes at very irregular intervals, instead of spacing them evenly in the rows. The machine was jacked up and driven by an electric motor to give the mechanism an equivalent speed of the 3 m.p.h. travelled in the field. Slow-motion shots were then taken in order to analyse the action more carefully and appropriate modifications recommended to the maker.

Not much can be said to generalise on this aspect of the work. All jobs are different and are carried out in co-operation with the section concerned. The film section is really a small service department of a large organisation, and must be prepared to be called on by anyone to deal with whatever problems arise.

Films In Tyre Research

Another use for this type of film was in connection with tyre research. The object of the work was to investigate the circumstances which cause side-wall wrinkling of pneumatic farm tractor tyres. The formation of the wrinkles always takes place in one area of the tyre and if this particular type of tyre deformation is allowed to continue the tyre is soon ruined because the layers of canvas which form the foundation are forced apart and break down.

A mechanical method of recording the beginning of side-wall wrinkling as the pull of the tyre is increased, was not available. The problem was, however, satisfactorily solved by making a film record of the shape of the area of tyre wall where it was known that wrinkling would ultimately take place, showing at the same time, a dynamometer dial which was registering the pull developed by the tyre. The pull at which tyre side-wall wrinkling commenced could then be readily obtained directly from the film and this technique was used for investigating tyres which contained various proportions of water filling and different inflation pressure.

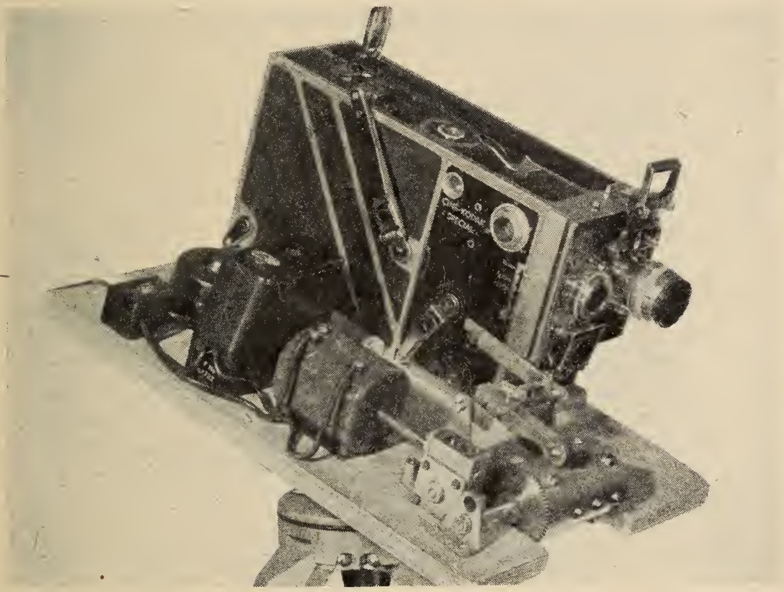

Fig. 3. Time-lapse equipment fitted to Cine-Kodak Special. The drum revolves once in three seconds ; the studs enable exposures to be made at intervals from half-a-second to three seconds.

The other main function of this section is to provide a link between the Institute and the outside film world. Specialised films are frequently borrowed from various sources at the request of members of the staff. Instructional films are shown for general information and foreign films are borrowed and sometimes exchanged for the Institute's films. In this way the Institute maintains contact with the work which is being done by similar organisations overseas.

Equipment

As it has been said, all this work is done on 16mm. This meets the demands admirably, both because of its lower cost and size for storage, and particularly because of the portability of the apparatus. Portability is essential because both the camera and projector have invariably to be carried long distances and set up in awkward places. The Cine-Kodak Special camera has proved itself suitable for all this work. A small time-lapse device has been made to couple to the camera and run from a 12-volt car battery. Thus the whole unit is portable and can be set up wherever it is required. For the super slow motion work, as previously mentioned, the Institute is hoping shortly to have its own High Speed Camera.

Various odd items of special apparatus have been constructed. For general transport there is the usual camera van—which is a converted A.R.P. rescue van with a reinforced roof. For a number of shots in the film " Tractor Ploughing " it was necessary to take from high angles, sometimes looking straight down on to the ploughing. To do this a wooden tower with an overhanging top was built on to one of the tractor trailers to enable it to be set up anywhere in the field.

As the majority of the subjects are machines travelling across fields, many of the shots are pans. However, these are not always satisfactory because of the changing angle of view as the machine goes by, therefore a set of portable rails is being built to enable tracking shots to be made. Constructing a level track on an uneven field is a difficult and lengthy process, so these rails are mounted on a ten foot low-based trailer with a ten feet extension to clamp on each end. This gives a 30 ft. rail which can be towed into position either behind the van, or by tractor if conditions are bad, and fixed up for work very quickly. The Institute is very fortunate in having its own workshop facilities, so that a joiner and fitter can soon give a hand if required.

Staff of Film Unit

The staff is very small, consisting of one cameraman and one assistant actually on film production, although the N.I.A.E. studio also includes a still photographic department and an art studio, both of which work in close co-operation. As in all small departments of this type it is essential that all members of the staff should be as versatile as possible. Very few people are in the position of being able to follow a film through from script preparation to shooting and editing. In a large film production unit, of course, this would be absurd, but for a small department of this type it works out very well. The chief advantage is the fact that the film staff have had practical farming experience, and are therefore fully conversant with all the subjects in question. This is where the resident film unit scores over the outside unit. Not only can it be relied on to be on call when necessary, but it can offer expert advice on the best way of planning and recording a sequence. In an emergency the camera team can be relied on to go out and make an intelligent record without an elaborate script, as would be required by an outside unit.

Although what has been said has referred mainly to the activities of the N.I.A.E., the agricultural engineering film is by no means limited to the use of this body. However, as this organisation forms what may be called the hub of the industry in England, the use which it makes of the film can be taken as typical of the part which this aid to science is playing in a vital industry.

DISCUSSION

MR. G. H. SEWELL : Is it your practice to make a number of copies of original films and how do you do it ?

THE AUTHOR : We normally only have one or two copies. We use reversal dupes.

MR. H. J. O'DELL : Have you found any particular need to utilise films for examining the behaviour of electrical equipment ?

THE AUTHOR : So far we have not had occasion to make any research films on the direct application of electricity.

MR. F. E. ROWLAND : The Electrical Development Association made a film which was completed in 1948 entitled " Electricity in Clean Milk Production." This was completed shortly before I visited the United States and I took a copy with me and showed it on about twelve different occasions, including to the United States Department of Agriculture. Wherever it was shown it received high praise, not only on account of its technique as a film, but also for its demonstration of the wide use of electricity in milk production and the high standard of cleanliness on our farms.

MR. LANGLEY : Do you make films for market gardeners and small-holders ?

THE AUTHOR : No instructional films are made. The horticultural section of the Institute has made record films.

STANDARDISATION AND THE KINEMA

Discussion Meeting arranged by the B.K.S. Theatre Division, on October 9, 1949

INTRODUCTION

S. B. Harrison-Swingler, M.B.K.S. *

SOME time ago the Theatre Division Papers Sub-Committee received a request from a projectionist who posed the following question : " What is all this business about standardisation and exactly how will it affect my job ? "

In order to understand exactly the effect of standardisation on the work of the projectionist, it is necessary first of all that the projectionist should be aware of the fundamental aims of standardisation, of the way the British Standards Institution works, and the reason why manufacturers, distributors and users, as well as other interested bodies, such for instance, as Local Authorities, get together round the committee tables to solve amicably the many problems of standardisation.

Therefore the Theatre Division has brought to this meeting several members who represent the Society on B.S.I. Committees. They are going to explain in a few words their particular relationship to this question of standardisation. Their contributions will provide coverage of the varied aspects of standardisation.

In point of fact the work carried out under the auspices of the British Standards Institution in this country will eventually have a far-reaching effect on the work of the projectionists in this and other countries, as well as having other important aspects from both the national and international point of view.

Technical Committees

The Kinematograph Industry Committee has been or is engaged on standardisation covering the following items :—

CME/ 2—Motion Picture Films.
CME/ 3—Standard Release Print Reels.
CME/ 4—Electrical Equipment.
CME/ 5—Projection Equipment.
CME/ 6—Inflammability of Films.
CME/ 7—Terminology.
CME/11—Screen Brightness.
CME/13—16mm. Sound Projectors.
CME/14—35mm. Sound Projectors.
CME/15—Seating.
CME/16—Projection Lenses.
CME/17—Standard Forms.
CME/18—Sub-Standard Projection Lenses.
ACM/6—Electro - Magnetic Sound Recording.

Each of these main committees appoints sub-committees dealing with widely varied items such as transit cases, spools, rectifiers, safety lighting, stage electrical equipment, electric meters, transformers and chokes, exit-boxes, rewinders, splicing machines, film storage cabinets, test films.

B.S.I. committees afford a very convenient means of getting together the various trade organisations under an impartial chairman, with the backing of an efficient secretariat and organising body. In various committees representatives are to be found of the British Kinematograph Society, the Cinematograph Exhibitors' Association, the Kinematograph Renters' Society, the Kinema Manufacturers' Association, the Home Office, the London County Council, Provincial Licensing Authorities, Kinema Projectionists' and Engineers' Association, British Film Producers' Association, the Royal Air

* Circuits Management Association Ltd.

Force Cinema Corporation, the British Sound Recording Association, Army Kinema Corporation, the Royal Navy Film Corporation, the Royal Photographic Society. Opinions are therefore at the service of the varied committees covering manufacturer, distributor and user.

I would like to remind you that when the Theatre Division was inaugurated over five years ago on the 13th June, 1944, our present Deputy Vice-President, Mr. E. Oram, presented a short paper on " Standardisation and the Kinema," in which he urged full Industry participation in the task of preparing a series of kinematograph standards. Owing to a previous appointment Mr. Oram is unable to be present this morning, but he sends his regrets and a message to the effect that the question of industry standardisation is still very close to his heart, and he hopes that this morning's meeting will show the great amount of work carried out ; further, that it will encourage all interested parties to give full support in the future.

We have with us Mr. M. J. Parker, of the British Standards Institution, who is secretary to the Kinematograph Industry Committees, and who will take part in the subsequent discussion.

STANDARDS AND THE EXHIBITOR

Leslie Knopp, Ph.D., M.Sc., F.B.K.S.

I DO not think the members of the Cinematograph Exhibitors' Association, who are astute business men, would devote time and money to the advancement of British standards unless they felt assured that they were fulfilling a useful and necessary service to the kinematograph industry.

But as consumers they are quick to appreciate the advantages which standards can offer—not only in the standardisation of physical dimensions, which is of itself of considerable importance to ensure interchangeability or proper fitting of replacement parts, but in the specification of quality, performance and test. Thus, by demanding that equipment, fittings or accessories shall comply with the appropriate British Standards Specification, the purchaser is able suitably to safeguard his interests.

Where an industry has an international character, international standards are of considerable importance. Through the International Standards Organisation a very large measure of agreement has been reached with the representatives of the kinematograph industry in foreign countries ; and thus films and much of the equipment associated with kinematography can be used universally.

STANDARDS FOR PROJECTION EQUIPMENT

S. A. Stevens, B.Sc., M.B.K.S.*

THE advantages of standardisation of electrical plant in the kinema do not appear to be so obvious to the projectionist as some other forms of standardisation, with the result that the work being done in the B.S.I. at present is the concern of technicians, manufacturers and purchasers, with the man who has to use the equipment as a seemingly disinterested party.

Thirty years ago, dimensions were an important feature in standardisation of of electrical equipment ; plugs and sockets and conduit threads were the sort of components undergoing standardisation. In this past period some rather curious things occurred with regard to standardisation and commercial greed. There was at one time a metal-filament lamp manufacturer who made lamps that would fit any holder, but made holders that would only take his lamps. If it were not for standardisation, this sort of thing would go on to-day, perhaps in not so obvious a way but certainly more insidiously.

* Westinghouse Brake & Signal Co. Ltd.

Where electrical equipment, such as arc rectifiers, was concerned, mechanical dimensions were not particularly important : there was not the necessity for interchangeability, as replacement of plant in a kinema was always accompanied by other major changes. Standardisation of such plant was therefore concerned with performance. The proposals for such standardisation had arisen in connection with Home Office regulations, and it had been found that the manufacturers of the equipment were in favour of such standardisation. From the point of view of the Home Office, standardisation of electrical performance was desirable as a guarantee of safety in use. Standardisation from the point of view of manufacturers would mean a reduction in the number of types of equipment to be made, and hence a reduction in manufacturing costs.

Standards and the Exhibitor

The reaction of the kinema proprietors was interesting : the largest kinema circuits appreciated the advantages to them of such standardisation in the form of guaranteed performance and reduction in manufacturing costs ; but curiously the smaller kinema proprietors were inclined to be suspicious. They feared that any co-operation between manufacturers and the Home Office authorities would have the effect of making their present equipment obsolete, and of making new equipment more elaborate and therefore more expensive. The converse is true, because of the reduction in manufacturing costs by standardisation ; while at the same time, the small kinema proprietor will have a guarantee of performance which obviously he has not had, and has had to rely on past experience, or experience of his friends in near-by towns.

In the past, the lack of a standard as a guarantee of performance has hampered progress, so that again, standardisation, instead of hindering progress as is sometimes suggested, would in fact hasten it, because whereas in the past any new idea was looked upon with suspicion until some purchaser was venturesome enough to try it, any such new designs would now carry with them a guarantee of satisfactory performance. One only has to look at the sound industry in its early stages as an example of what can happen when there is no standard of quality.

INTERNATIONAL STANDARDISATION

Major C. H. Bell, O.B.E. M.B.K.S.*

IN our endeavour to standardise we are inclined to be national rather than international. If we are to become international, then designs of equipment generally must be in line with that of other countries. I am not referring to the aesthetic side but rather to dimensional standards such as optical centre heights, etc.

I am inclined, generally, to blame the user for the maintenance of obsolete standards. I think the time has come when manufacturers should refuse to make out-of-date non-standard equipment.

At the present time, if a customer is prepared to pay, manufacturers will make up any old equipment to suit his requirements. That, in my opinion, is economically unsound, both from the point of view of the manufacturer and the customer.

One of the best things that the British Standards Institution has done recently, is the introduction of a standard of projection lenses. British lenses are sold all over the world, and if manufactured in accordance with the agreed standard will fit perfectly into any modern projector.

Regarding the projectionist the question of standardisation very rarely affects him, as he is generally dealing with his own projection room and what

* G. B. Kalee Ltd.

is in it. His advice on matters of operation is useful and important, but I find that in many cases we are inclined to accept his viewpoint, which is naturally limited, and is generally based on what he, as an individual, prefers, whereas I contend that the question should be examined in a much broader light of what is considered general opinion.

Anglo-American Co-operation

We should all examine carefully what other people do throughout the world, and the aim should be standardisation on this basis. I think it will be agreed that we have accepted foreign practices which are contrary to our own British practice, but this does not say that they are wrong, and it is not all one-sided. If we refer to the question of spool spindle sizes, I believe that in view of the introduction of the standard 2,000 ft. reel, the Americans prefer our $\frac{3}{8}$ in. standard spindle to their $\frac{5}{16}$ in., and I look forward to our agreeing with the Americans on a satisfactory standard for spindle sizes which could become known as an international standard. Again, unfortunately, we have British manufacturers who have departed from what is generally referred to as the British standard $\frac{3}{8}$ in. spindle, which only results in further complications.

I believe very thoroughly in the practice of unit construction, and if this can be linked with international standards then it does mean that any part of any equipment could be used anywhere in the world with any part which could be supplied by any country. I am referring particularly to projectors, arc lamps, stands, etc., as complete units, as I appreciate that components which go to make up these various units are matters for the particular designer, whose opinions naturally vary in different countries.

B.S.I. Mark

The British Standards Institution mark is respected as well as any other mark in all countries throughout the world, and the more that we can get equipment manufactured to agreed standards and specifications the easier will be the problem of the manufacturer and the result must be a cheaper article for the consumer.

I would like to place on record our appreciation of the splendid work of the B.S.I. and with special reference to the kinematograph equipment industry, my only criticism being that we as an industry do not make sufficient use of the facilities which the B.S.I. offer in providing the medium for round-table discussion and the setting up of standards acceptable to all concerned.

STANDARDISATION COMBATS FILM MUTILATION

R. Howard Cricks, F.B.K.S., F.R.P.S.

IT is now nearly forty years since Arthur S. Newman (later to be Vice-president of this Society) initiated his campaign for standardisation—the first proposal of its nature in our industry. His chief concern was to ensure that any film, whatever its origin, should run upon any piece of equipment.

It may be remembered that even in comparatively recent years this was not always the case. Continental negative stock, made to a width of 35 mm., sometimes caused trouble in running through equipment the gates of which were made to the British and American standard of $1\frac{3}{8}$ in. Discrepancies between the pitch of perforation and the diameter of sprockets caused strained perforations.

Newman's work formed the basis of the standards prepared in this country by the Kinematograph Manufacturers' Association. When the Society of Motion Picture Engineers was formed in America, one of its first activities was the adoption of these standards with only minor amendments.

Mechanical Standardisation

These original specifications showed the same type of perforation for both negative and positive stock—a circle with two flats. At a later date Bell & Howell introduced the rectangular perforation which is to-day used on all positive films (with the exception of Technicolor and laboratory positives). Experience has proved the original contention that due to its radiused corners and slightly greater length, it gave a longer working life to the film.

The American standards formed the basis of practice in every country in the world. Thus Newman's original endeavours have been crowned by the fact that to-day film mutilation due to mechanical mismatch is a thing of the past.

There is, however, one matter not finally determined. For many years the intermittent sprocket has been made to a working diameter of about $\frac{15}{16}$ in.—actually from .932 in. to .936 in. Experiments in America have shown that a diameter of .943 in. gives rise to less wear upon the film, and this is the diameter which will be ultimately standardised.

The principal reason for this increase in diameter is of course that modern film stock shrinks less than that of even ten years ago ; the indications are that the new tri-acetate base, unlike former safety base, has an even lower rate of shrinkage, and it may prove that a still larger sprocket may be advantageous.

Film Mutilation Committee

Nevertheless we may fairly say that on the whole, purely mechanical causes of film damage have been overcome. In 1946 the British Kinematograph Society appointed a technical committee, which included representatives of other interested bodies, "To investigate the problem of film mutilation in all its aspects, and to recommend appropriate action." Its report indicated that by far the worst causes of mutilation were various aspects of the handling of film. Most of the findings of this committee are embodied in British Standard Specification 1492 of 1948, " 35mm. Cinematograph Release Prints."

The B.K.S. committee spent a considerable time studying the problems of mechanical damage of green prints. It strongly recommended that all prints when new should be waxed or otherwise processed, to prevent emulsion pick-up in the projector gate. This is a recommendation made in the above-named specification.

Of even greater importance was the recommendation—which followed American practice—that the 2,000 ft. reel should be adopted for all release prints. This again is embodied in the specification, but as is generally realised, the requirement must necessarily come into operation gradually, because of the difficulty of replacing cans and transit cases.

The 2,000 ft. Reel

The advantages gained by the despatch by the renter of films in 2,000 ft. reels need not be stressed. Practically every projectionist insists—quite wisely—upon projecting double reels. To double up single reels entails removing alternately the leaders and run-outs of reels, and splicing the reels together ; at the end of the run, the film must be cut at the appropriate point (so losing at least two frames of film each run) and the leaders and run-outs replaced. Apart from the fact that the average standard of film splicing in the kinema is deplorably low, there is always the risk that the reels may be divided at the wrong place, and the leaders and run-outs joined to the wrong parts, either leading to confusion in subsequent runs.

Another factor stressed in this specification is the need for visibility of change-over cues. When the cue dot occurs on a dark scene it is often difficult to see it unless it is clearly ringed in white. While this was a requirement of the original American specification it has been often ignored. The new specification gives precise information on two methods of producing the transparent ring.

But even though standardisation of films should become fully effective, there will still remain the problem of the human element. Standardisation will not render extinct that race of pseudo-projectionists who are convinced that their audiences are more interested in seeing their scratches and heiroglyphics than in watching the picture ; although the double reel certainly restricts their scope.

The ultimate need is for something beyond the abilities of the B.S.I. to secure—a standard projectionist.

DISCUSSION

Major C. H. Bell : The introduction of the 2,000 ft. standard reel is something which I think this industry should for its own sake drive as hard as possible, because 90 per cent. of the mutilation of film takes place on Saturday night. You have only to see the way in which the film comes off the re-winder. I am very happy to know that in America they are going over very fast to the standard reel. The film goes out on 2,000 ft. spools and it never leaves the spool. The film mutilation from which we suffer to-day is automatically decreasing.

Dr. F. S. Hawkins : There is perhaps one direction in which there is a British standard which intimately concerns the projectionist—the one on screen brightness. Normally the equipment when first installed in a kinema gives a screen of adequate brightness, but there is much the projectionist can do to maintain that equipment year in, year out. At the beginning the lenses, port holes and screen are clean : after a while the port-holes and lenses may become dirty and the screen may lose reflectivity and change colour, and the screen brightness will drop tremendously. Good maintenance will greatly diminish this drop, and one must remember that the comfort of the patron in seeing the picture is greatly dependent upon adequate brightness of the screen.

There is another aspect—the effect of standards upon technical progress. Sometimes they will stimulate it. In this particular case one of the difficulties has been to find a method which would enable the projectionist to measure the brightness of his screen. It is easy to measure the illumination falling upon it ; a method of measuring the reflected brightness has not been easy to find. Those of you who have read the publications, both in America and in this country, will realise that the standards have stimulated the development of a suitable meter. But this same standard possibly illustrates that unless it is applied cautiously it may hold up progress. The appendix to the standard states that it applies only to the present prints, and that if it were possible to increase the brightness considerably—I believe the figure was five times—prints with a much greater range of gradation could be used. Therefore it behoves us to bear this in mind, and not think that a standard of so many foot-lamberts is settled for ever.

Mr. A. E. Ellis : I would like to support what was said by Mr. Cricks. I have had a great deal to do with getting the double reel on to the market and I should like to make a recommendation that we do press that it be accepted more quickly than is the case. There are still many of the British and American companies that are not sending out double reels. My experience is that mutilation has dropped considerably with the use of the double reels. Mention was made of perforation damage decreasing—this is the case. Most of our troubles are from scratching which is due to bad handling; that can be, and should be, eliminated. The cutting and carving of fronts and ends of reels is a thing of the past as far as my company is concerned, because every feature is doubled up. We can get through far more work with less staff and give more satisfaction.

On the matter of screen illumination, I do not think sufficient has been done so far to get the standard adopted. There is a theatre not far from here used considerably for trade shows, and it does not matter how dark a print you have, there they bleach it for you ; they have too much light. Last week at a large suburban house, I saw a film in which the picture was so dark, you could not see it to advantage. When we pass a first print we are sometimes told, " You are turning out stuff that is too light." At the back of our minds we know that if you give a theatre a dark print, the projectionist may use all the current he has got and still not put over a good picture. If, on the other hand, a light print is sent out, the light can be cut back, but if we could get down to a standard, we could say " this is our standard density," and almost everybody would be satisfied.

All are not agreed on whether film should go out on a spool or not. There was a disagreement as to the centre ; some favoured the standard two-inch bakelite centre, but my experience has been that when we have used these bakelite centres they come back crushed in the centre of a double reel. The usual small centre is good enough provided that a small bobbin of hard wood is put in the centre to take the strain.

I do not agree that standards should be international, but I find that standards in this industry are inclined to be American—I feel that we should not introduce as British standard, something that comes from America simply because it is American.

DR. F. S. HAWKINS : The standard which the last few speakers have discussed is one of screen *brightness*, which is rather a different thing from screen illumination.

MR. R. PULMAN : Nobody who reads any British standard yet produced on the subject of kinematography doubts that it does most vitally affect the work of the projectionist. It enables him to do his job much more efficiently.

Nobody this morning has yet said anything against standardisation. In approaching standardisation one should be very cautious indeed. I remember at a debate of the Illuminating Engineering Society not long ago a standard was defined as " The establishment of the least common denominator." Standardisation can easily defeat its own object. I do feel that everybody who is concerned with these B.S.I. committees should approach the matter with every precaution to ensure that no undue limitations are imposed upon designers.

MR. S. A. STEVENS : Two points which Major Bell brought up have not been dealt with. One was the point of the international feature of standardisation. None of us is against that. My experience of the work of the B.S.I. is that it does fit in very well, not only while the committee is drawing up the specification, but for years afterwards. They have a system whereby they receive copies of overseas specifications, they put them before the committees, and long after they keep sending them to us. That gives an opportunity sometimes for re-opening the procedure, and possibly considering a bright idea from some foreign country.

Another point raised by Major Bell was that of the user asking for something not standard, and the manufacturer supplying it. I am of the opinion that this problem will solve itself, because if equipment is standardised, the manufacturer is in a much better position to produce a steady run of that equipment and therefore costs will be lessened. A non-standard version of it will therefore inevitably cost more, and the user will soon appreciate that it does not pay him to continue asking for non-standard items.

MR. R. H. CRICKS : We on the B.S.I. committees do a large amount of work in preparing specifications, and the B.S.I. do an excellent job in issuing them. But there is insufficient publicity given to them ; users have no knowledge of standards. What is the B.S.I. doing to bring specifications to the notice not only of technicians, but of the buyers ?

MR. M. J. PARKER : When Mr. Cricks mentions the user I presume he means the user in the kinematograph industry. It should, however, be appreciated that with some British Standards the user is the man in the street and in those cases effective publicity would be expensive. The B.S.I. has no advertising grant and does not advertise in that way. The function of the B.S.I. is to produce a standard and this is issued only when there is general agreement that it fulfils a generally recognised need, and has been approved by both the producers and users.

As far as general technical publicity is concerned the Institution has a most comprehensive press list which includes all the technical journals in Great Britain and also House magazines and Associations' bulletins. The appropriate press are circulated with a notice of every new and revised British Standard issued and are offered a free copy of the standard. The Institution also has a number of overseas journals on its list, including some in the British Commonwealth.

In regard to publicity in the kinematograph industry in particular, to which I presume Mr. Cricks refers, there has recently been established a Press Relations Sub-Committee which, although it has not yet met, will be doing so shortly. The committee is composed of editors of the technical journals concerned with kinematography, under the chairmanship of Mr. E. Oram, who represents the Cinematograph Industry Standards Committee. The purpose of the committee will be to supply the technical press with all the information they might require on new British standards, including the reasons for requirements which might otherwise be questioned. It might also be possible to arrange, with the help of the committee, to secure the expression of public opinion in places where such an expression of views might help the committee to make a decision in regard to certain matters upon which it might be in doubt.

One advantage of standards is that their use enables the designer and engineer to treat as routine all matters which have already been studied, leaving them free to concentrate on really creative work. Again the preparation of a British standard frequently focuses attention on a particular problem and thereby stimulates fresh research.

One vital factor bearing upon this question of progress is the matter of the revision of a standard. These standards are reviewed whenever necessary to keep abreast of scientific and technical developments and if there is frequent revision there is little, if any, opportunity for standardisation to hinder progress.

The question was raised of the representation of small companies on B.S.I. committees. Where a small firm is not represented it should transmit its opinions through the appropriate trade organisation.

The international aspect of standardisation has been discussed with particular reference to American standards. We do not want simply to follow the Americans, but, on the other hand, we must remember that the advantages in having a common standard often justify the adoption of a British standard which might be a little different from that which we might establish ourselves.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library.

PHOTOGRAPHIC GRANULARITY AND GRAININESS.

L. A. Jones and G. C. Higgins, *Sci. et Ind. Phot.*, June, 1949, p. 201.

A new concept of granularity measurement is introduced based on the realisation that graininess is perceived by virtue of a scanning process carried out by the eye on the granular deposit. W. F. B.

THE BRIGHTNESS OF THE SURROUNDING FIELD AND ITS INFLUENCE ON CORRECT SUBJECTIVE REPRESENTATION (OF PICTURES).

J. Eggert, *Sci. et Ind. Phot.*, June, 1949, p. 204.

The author demonstrates that pictures should be viewed with a surrounding field the brightness of which corresponds to that which one would expect to find in a similar field under naturally occurring circumstances. W. F. B.

USE OF TEST FILMS

G. Lechesne, *Tech. Ciné.*, May 31, 1948, p. 118; June 30, 1948, p. 147.

A series of 35 mm. test films, standardised by the Comité Technique du Cinéma, comprises films for checking picture steadiness (having holes in the frame area punched at the same time as the perforations—also available for 16 mm.); for centring the projector on the screen; for detecting picture distortion by means of a grid; buzz-track, frequency films, and warble-tone tracks. Methods of measuring screen brightness are also specified.

R. H. C.

PRE-SELECTION OF VARIABLE-GAIN TUBES FOR COMPRESSORS.

Kurt Singer, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 684.

The procedure described includes the use of a valve matching circuit in which an alternating test voltage is applied in phase to the two signal grids of the pair of valves under test, and the out-of-phase voltage at their anodes is measured. The test is carried out both for small inputs at zero bias and also, by means of a rectifier clamp circuit, for large inputs under dynamic, or self-biassed, conditions. N. L.

ZERO-SHIFT FOR DETERMINING OPTIMUM DENSITY IN VARIABLE-WIDTH SOUND RECORDING.

C. H. Evans and R. C. Lovick, *J. Soc. Mot. Pic. Eng.*, May, 1949, p. 522.

The authors describe a method for the direct measurement of envelope distortion by comparing the mean densities of modulated and unmodulated tracks. The apparatus required is relatively simple and only a minimum of film is required. Results, if proper precautions are taken, are found to agree well with the more usual cross-modulation tests.

M. V. H.

THEATRE LOUDSPEAKER DESIGN, PERFORMANCE, AND MEASUREMENT

J. K. Hilliard, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 629.

After discussing the scope and purpose of loudspeaker testing in relation to design, the author describes the technique of open-air free-field measurement. Examples are given illustrating tests for phasing, balancing of multi-way systems, impedance matching frequency response and harmonic distortion. N. L.

THEATRE TELEVISION SYSTEMS.

Richard Hodgson, *J. Soc. Mot. Pic. Eng.*, May, 1949, p. 540.

The apparatus in the Paramount Theatre, New York, employs the intermediate film principle by which the television programme is recorded on 35mm. film from the picture on a cathode-ray tube, and after rapid processing the reel of film is passed down to the projection box for inclusion in the programme of the theatre. Photographs and certain technical details of the rapid processing machine are given. The Kodak hot process is used in which film travelling at 90ft. per min. is completely processed for projection in 40 sec. T. M. C. L.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

Projectionists' School

A school for projectionists has been opened in Berlin. In five projection rooms are installed projectors of all types ; the course lasts eight weeks. Adjoining is a sub-standard department where shorter courses are run for school-teachers.

Foto-Kino-Technik, Nov. 1949.

" Black-light " Painting

The artistic and technical aspects of painting in fluorescent pigments, which glow in the light of ultra-violet lamps, are discussed. A practical brightness range of 130 to 1 can be obtained.

Philips Tech. Rev., Nov. 1949.

Hungarian Colour Film

The first Hungarian colour film is now being produced ; no information is given as to the process.

Cultural News from Hungary, Oct. 1949.

Stereoscopic Perspective

In an article on stereoscopic vision, a novel aspect is presented : that the effect of binocular vision is to decrease the apparent width of objects and increase the apparent width of the spaces between them.

Inter. Phot., Nov. 1949.

Kolorig Screen Surround

At the Fontainebleau kinema, Paris, the screen, without masking, is mounted in front of a larger screen, which is colour-flooded.

Tech. Ciné., Nov. 1949.

New Filament Lamp

A new incandescent lamp announced by G.E. of America produces an estimated 900,000 candle-power. It is intended for use in spotlights. The lamp is of tubular shape, only 4 ins. in diameter, of the bi-post type.

J. Soc. Mot. Pic. Eng., Oct. 1949.

Starke Cycloramic Projection Screen

It is claimed for a new projection screen that it utilises fluorescence from the ultra-violet of the incident light, to enhance the brightness of the picture.

Inter. Proj., Oct. 1949.

Progress towards International TV Standards

At a meeting of the International Radio Consultative Committee held at Zurich last July, various aspects of television standardisation were discussed. It was agreed that frame frequency must be linked with mains frequency. The number of lines favoured varied from 405 to 819.

Electronics, Oct. 1949.

THE COUNCIL

Meeting of December 7th, 1949.

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), E. Oram (*Deputy Vice-President*), Rex B. Hartley (*Hon. Secretary*), W. M. Harcourt (*Past President*), M. F. Cooper, F. G. Gunn, H. S. Hind, B. Honri, T. W. Howard, I. D. Wratten, R. H. Cricks, (*Technical Consultant*), and W. L. Bevir (*Secretary*).

Accounts.—Approval was given to the accounts and cash statement, and the Past President was congratulated on his formulation of a budget which was proving to be so accurate.

New Premises.—Negotiations were reported with the British Film Academy for the occupation of part of their premises in Piccadilly. The President and Vice-President were authorised to continue negotiations.

Educational Foundation.—A sum of £250 was allocated for the inauguration of a fund to further the educational work of the Society.

Committee Reports.—Mr. Cricks reported the last meeting of the Journal Committee, and Mr. Knopp that of the Papers Committee, both of which were approved.

The Constitution.—It was agreed that in future copies of the Constitution be sent only to Corporate members, and not Associates and Students.

Film Production Division.—Approval was given to an invitation to the Incorporated Association of Kinematograph Manufacturers to co-operate with the Society in the demonstration of equipment to be held on the occasion of the visit to Ealing Studios on May 13th, 1950. Mr. Honri reported the success of a drive for increased membership, but it was felt that it would be worth while to reinstitute the system of sending out postcards informing members of each meeting.

1951 *Exhibition.*—A sub-committee appointed to consider co-operation in the Festival of Britain consisted of Messrs. Hind, Cooper, Howard and Cricks (Chairman).

Presentation.—A case of pipes was presented to Mr. Oram, by the President, from his colleagues, as a token of esteem and appreciation for his many years service to the Society as Hon. Secretary.

EXECUTIVE COMMITTEE.

Meeting of December 7th, 1949.

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), W. M. Harcourt (*Past President*), Rex B. Hartley (*Hon. Secretary*), I. D. Wratten, W. L. Bevir (*Secretary*), and Miss S. M. Barlow (*Asst. Secretary*).

Elections.—The following were elected :—

Gerald Gordon Portch (Member), Westinghouse Brake & Signal Co., Ltd.
Ralph Douglas Hogg (Associate), Ealing Studios Ltd.
Stanley James Gudgeon (Associate), Weyers Bros. Ltd.
Eric Horvitch (Member), National Film Production (Pty) Ltd., Johannesburg.
Albert Edward Clarke (Member), A.B.P.C., Ltd.
Herbert Vivian Shaw (Associate), Ealing Studios Ltd.
Reginald Emrys Napper (Member), Booker Bros,. McConnell & Co., Ltd., British Guiana.
Arthur Bradburn (Member), Ealing Studios Ltd.
Cedric George Thomas Bailey (Associate), G. Humphries & Co., Ltd.
Roy Alfred Driver (Associate), Herschells Films Pty., Ltd., Australia.

Transfer.—John Claude Tetard was transferred from Associate to Corporate Member.

Death.—The death of William Leonard Johnson (Associate), was noted with regret.

Resignations.—The resignations of an Associate and a Corporate Member were accepted with regret.

COMMITTEE MEETINGS

Theatre Division Committee—Nov. 24, 1949

The Deputy Chairman, Mr. S. A. Stevens, presided in the absence of the Chairman. One Member and two Associates were enrolled in the Division.

The poor attendance at Sunday morning meetings was discussed, and it was agreed to ask the Papers Committee to make provision in the 1950-1951 Lecture Programme for some meetings of the Division on weekdays.

The complaints of Mr. Turner, Secretary of the Newcastle Section, were discussed by the Committee and Mr. Knopp referred to the many letters which he had written to which Mr. Turner had not replied.

Film Production Division Committee—Nov. 30, 1949

A campaign to enrol members from film studio workers was agreed upon, studio representatives undertaking to form subcommittees for the task. Each would be supplied with a list of people in the studio who had already joined the Society. In spite of complaints that posters announcing meetings were too big for studio notice boards it was agreed that they remain the same size. The Chairman and Hon. Secretary were empowered to approve enrolments to the Division.

It was agreed that the annual studio visit for 1950 should be held on 13th May, to Ealing Studios. The Chairman said that Ealing Studios' Management had agreed, subject to the usual restriction to a maximum of 200 visitors, plus 50 exhibitors (or their guests). Space would be made available for a K.M.A. exhibition of equipment.

Journal Committee—Nov. 30, 1949

Alterations in format for BRITISH KINEMATOGRAPHY were approved and arrangements made to publish papers not read to meetings of the Society. Secretaries of Sections and studio and laboratory representatives are to be asked for co-operation in assisting in the compilation of personal news. The Papers Committee were asked to ensure that papers submitted for publication after being read to the Society were in a suitable condition for publication.

Acceptance of inserts in the Journal was made conditional upon at least half a page of advertising space being taken in the Journal.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

PERCY H. BASTIE, recovered from his recent illness, has resumed his duties as Hon. Treasurer.

KEN MATTHEWS, formerly of the C.E.A., technical department, is now recovered in health after a lengthy illness, and is able to accept employment ; he wishes to thank all friends who expressed sympathy.

W. NORRIS arrived in Johannesburg on December 5th to take up his appointment as general manager of the studios of African Film Productions.

Pan F & HP3 meet all your requirements

It's a big step from the hard brilliance of sunshine on an open beach to the sober light of a city street on a wet November afternoon, but you can make the best of both worlds with just two Ilford films—Pan F and H P 3. When the light permits, Pan F offers its twin advantages of evenly balanced colour sensitivity and negligible grain size. For shots in really poor light and for studio work, H P 3 gives you full pictorial quality plus the extra speed the occasion calls for.

ILFORD Pan F and HP3 16 mm NEGATIVE FILMS

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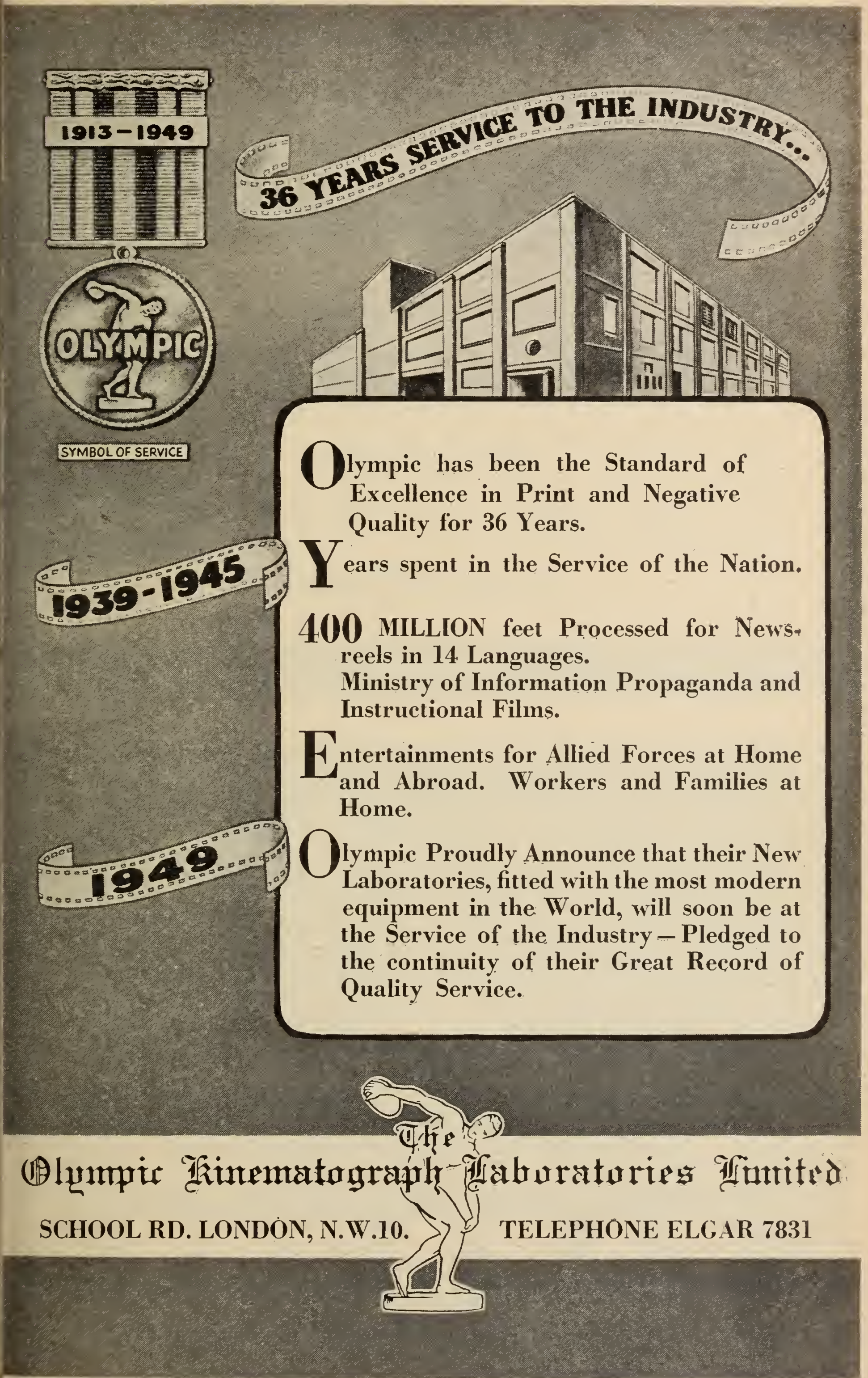

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Olympic has been the Standard of Excellence in Print and Negative Quality for 36 Years.
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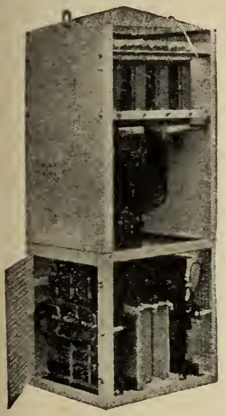
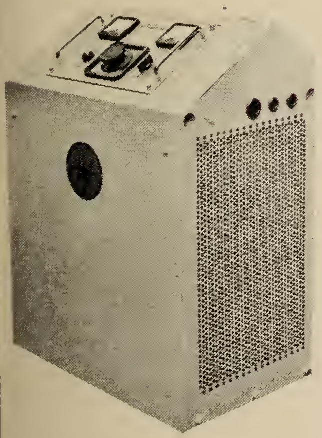


Twin H.I.60 equipments operate two arcs simultaneously during changeover at an efficiency at over 75% and are complete with ballast and control gear. Switches and meters, for fitting near the projectors, are supplied separately.

●



Single-phase sets incorporate a special circuit giving a three-phase output. No ballast is necessary and all controls and meters are built in so that the equipment may be housed in the projection box underneath the lamp-house.

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SIXTEEN, No. 2 FEBRUARY, 1950

THE SOCIETY ACQUIRES NEW PREMISES

The Council is happy to announce that new premises have been acquired at:—

117, PICCADILLY, LONDON, W.1.
Telephone Nos. GROsvenor 4396/7.

Carnegie House, 117, Piccadilly, is the property of the Carnegie Trust, and is let only to non-profit-making organisations. It is easily accessible, being situated between Green Park and Hyde Park Corner stations (Piccadilly Line).

The Society is indebted to the President and Council of the British Film Academy, and to the Bureau of Current Affairs, who have co-operated in making this accommodation available, at a rental suited to the resources of the Society.

The new premises allow a room to be reserved for the library, and the Library Committee hopes that all members will make full use of the facilities available.

The President has conveyed the thanks of the Council to Messrs. Technical & Scientific Films Ltd., for their great courtesy during our temporary occupation of the premises at 53, New Oxford Street.

A NEW APPOINTMENT

Miss Joan Poynton, whose appointment as Secretary to the Society was announced by the President last month, commenced her career as secretary to a Spanish merchant. After seven years in commerce, she became secretary to the British Red Cross Society Massage and Orthopaedic Clinics in Hertfordshire, which appointment she held for a further period of seven years.

In the interest of gaining wider experience, Miss Poynton next became assistant secretary of the Mental Health Emergency Committee which was appointed by the Central Association for Mental Health to deal with the problems arising during the war in that field.

After one year, Miss Poynton accepted the additional appointment of Secretary to the Women's Advisory Council of the Nuffield Provincial Hospitals Trust. Still retaining one of these appointments she became assistant to the General Secretary of the Royal College of Nursing, when she had opportunity of working closely with personalities of considerable reputation and ability.

Work of an experimental nature was carried out by Miss Poynton as organising secretary of an International Club, in which post she spent an educational though strenuous year. In 1947, she became Public Relations Officer of the Institute for the Scientific Treatment of Delinquency, when her work, broadly, centred on the development of national and international relations, the interpretation of policy and details of the work to the lay public and press, increasing membership and appeals.

Miss S. M. Barlow remains Assistant Secretary to the Society.

Photo by G. Scott Bushe

THE HEATING OF FILM AND SLIDES IN PROJECTORS

*Hugh McG. Ross, M.A.**

Read to the British Kinematograph Society on November 2, 1949.

IN virtually every projector the designer and users are faced with the problem of the heating of the film or slide in the gate. This is particularly severe with high-power theatre projectors or process projectors used in film studios for front or rear projection shots, or when the output of sub-standard moving or strip-film projectors is increased. It is, however, valueless to attempt to measure the temperature in the gate aperture with the aim of keeping this below the temperature at which the film or slide is damaged. Rather, the cause of the heating must be considered.

I. THE CAUSE OF HEATING

The energy radiated from the light source of a projector may be analysed as in Fig. 1, showing the distribution of energy throughout a spectrum which extends from the ultra-violet region, through the visible spectrum, and into the

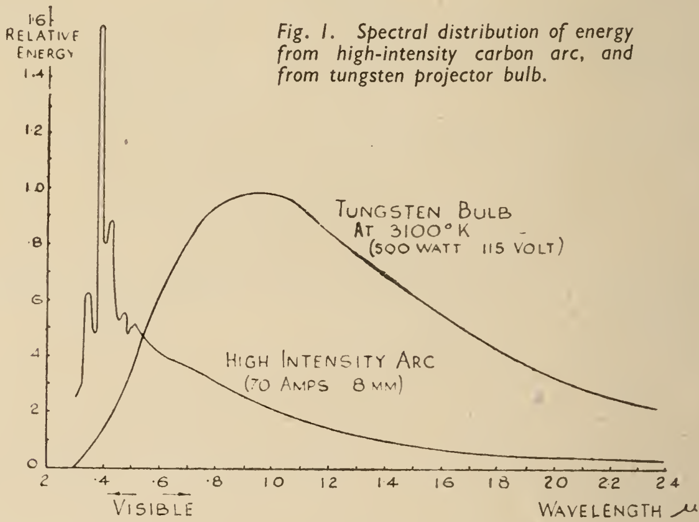

Fig. 1. Spectral distribution of energy from high-intensity carbon arc, and from tungsten projector bulb.

infra-red region. The curve for the high-intensity arc is considered to be fairly typical, although S.H.I. carbons may give a slightly greater proportion of visible light. The curve for the ultra-violet and visible wave-lengths was measured at the gate position of a Stelmar arc,[1] while the part of the curve in the infra-red is based on the radiation of a black-body at 5500°K[2]. This curve takes into account the radiation from the flame near the crater, as well as the radiation from the crater itself, this being correct for normal mirror or condenser lens optical systems.

The curve for a tungsten filament lamp (derived from Ref. 3) is typical of a Class A1 projector bulb as used in sub-standard equipment and film-strip projectors. The two curves are drawn to show approximately equal visual brightness, and demonstrate how the arc gives a lower proportion of heat, for the same visual effect.

*Formerly J. Arthur Rank Productions Ltd.

Heat-Absorbing Filters

In order to reduce the heating effect it is clearly desirable to remove the infra-red radiation, and perhaps also the ultra-violet radiation. Fig. 2 shows the absorption curves of some typical infra-red filters. It will be seen that water,[4] even in a very thin layer, is virtually opaque to radiation above 2·35 microns (1 micron= 1 μ = one-thousandth of a millimetre). This is of particular value in keeping cool the lenses and other parts of the optical systems, for crown-glass begins to absorb quite heavily at longer wavelengths than this.

Probably the best infra-red filter is provided by ferrous sulphate or ferrous ammonium sulphate dissolved in water.[5] The addition of a few drops of sulphuric acid makes the solution more stable. A convenient way of preventing the formation of air-bubbles on the windows of the cell is to add a few drops of detergent or wetting-agent such as "Teepol," which prevents the released air from adhering to the windows. A solution of the strength shown, when in a cell 5 cms. thick, has a very pale blue-green colour, due to slight absorption of the deep-red part of the visible spectrum, but for most applications this is hardly visible.

Perhaps the most convenient infra-red filter is provided by type ON20 heat-absorbing glass made by Chance Bros.[6] This is almost colourless (the curves of Fig. 2 have been drawn for ferrous ammonium sulphate and ON20

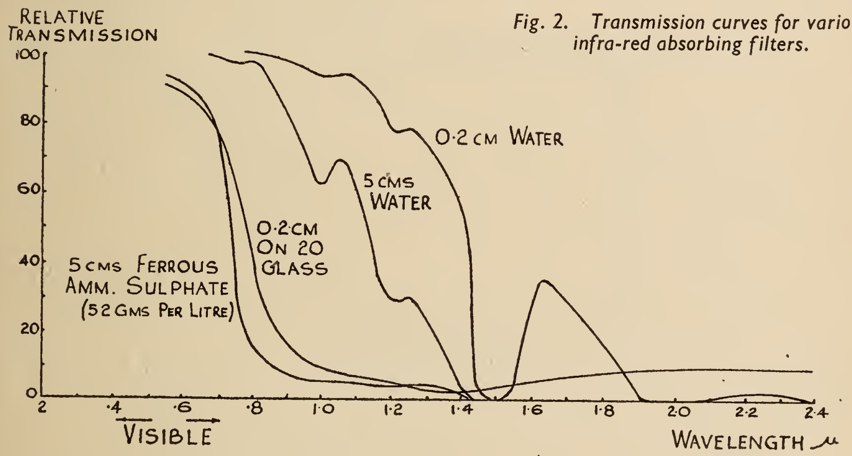

Fig. 2. Transmission curves for various infra-red absorbing filters.

filters appearing visually to have the same colour) while it absorbs well in the near infra-red. Its transmission increases slightly as the wave-length increases and only becomes negligible above 3.4 microns. For many applications this type of filter is suitable, and the heat which it absorbs may be dissipated by natural convection to the air, or the glass may be cooled by blowing air on it.

Combined Heat-Absorbing Cell and Lens

It is probable, however, that the most suitable infra-red filter for practical use in a high-power projector is a combination of a thin layer of water with a sheet of ON20 glass. This absorbs well in the near infra-red, provides full protection to the lenses and is reliable and stable in use. Fig. 3 shows diagramatically such a filter combined with the first condenser lens of a process projector.[7] The arc runs at 300 amps. with a 16 mm. positive carbon, and $2\frac{3}{4}$ ins. away from this is the front window of the cell $5\frac{1}{4}$ ins. diameter. This window is made of quartz in order that it may readily withstand the heat of the arc and its flame. On the other side of the quartz there is a narrow water channel, the water being constantly circulated by a pump and motor. The efficiency of cooling the quartz, and the whole front metal plate of the cell facing the arc, is so good that after running the arc at 300 amps. for 30 minutes it is possible to switch off, open the arc door and immediately hold one's hand against the quartz. A further consequence is that the cool quartz window is relatively little damaged by spatter from the arc, and being quite easily replaced, it acts instead of a spatter glass.

The light, after passing through the quartz and first water channel, passes through a sheet of ON20 glass and into a second water channel. The water channels serve the double purpose of cooling the ON20 glass, and also contributing to the filtering of the light. In particular, the first water channel absorbs much of the infra-red radiation, thereby reducing the amount which the ON20 has to absorb.

If only a heat-absorbing cell were required, the farther window could be made of optical glass. But in this present example the light next passes into the first condenser lens of the optical system. Because the filter has removed the radiation of wavelengths which might be absorbed by the glass, the lens

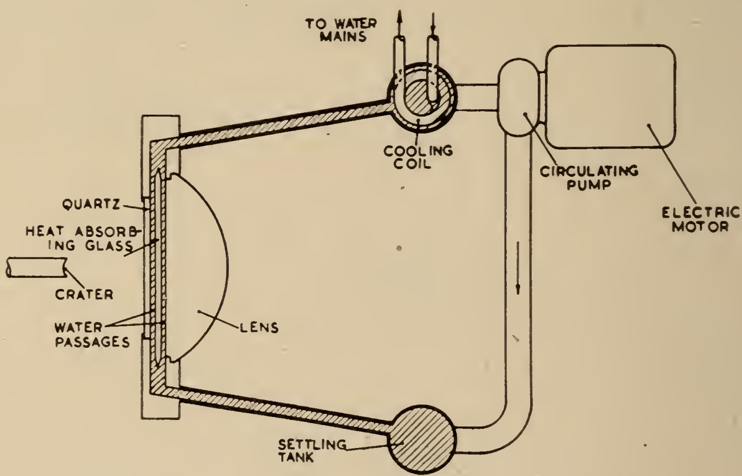

Fig. 3. Combined heat-absorbing filter and condenser lens for a projector.

does not get unduly hot and it is therefore made of crown glass for best optical performance. Similarly, the other lenses of the system are not heated seriously.

Only about 3 pints of distilled water circulate round the cell, and of course the heat which passes into the water has to be continuously removed. At each end of the cell are cylindrical tanks which ensure that the stream of water is evenly distributed across the aperture, and in one of those there is a coil of copper tube. Cold tap-water passes through this (and is used also to cool the water-cooled jaws of the arc) and the heat from the circulating water is transferred to the tap-water which runs to waste. Of course none of the tap-water gets into the cell.

Efficiency of Heat-Absorbing Cell

The total amount of heat taken up by this cell is 3,600 watts. About one-third of this is unwanted radiation removed from the light-beam, and the remainder is radiated on to the metal-work of the cell which is in the hot lamp-house.

It is estimated that such a cell and lens absorbs only 10% more of the visible light, compared with an ordinary lens. This is, in effect, recovered by avoiding the use of a separate spatter glass.

It may be added that the measured absorption of visible light from an arc by a simple cell comprising two glass windows and two inches of water is about 15%. The addition of 2 mm. thickness of ON20 glass to such a cell absorbs only a further 6% of visible light from an arc, due to low reflection losses. An ON20 glass filter in air absorbs about 12% of the visible light from a tungsten bulb.[6]

By combining the curves of Fig. 2 for filters with those of the light sources, Fig. 1, we obtain the distribution of the energy of the filtered light, Fig. 4. In the case of the arc, the dotted line shows the effect of filtering out the ultra-violet radiation with a filter similar to the Wratten 2A filter. When using a water-cell, this effect may be obtained by adding ortho-nitro-benzoic acid and a little sodium carbonate.

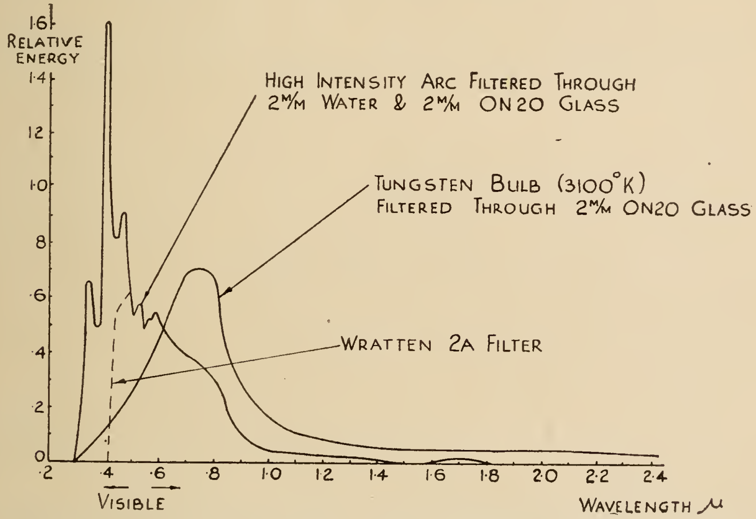

Fig. 4. Spectral distribution of energy from arc and tungsten sources. after unwanted radiation has been removed by practical filters.

Luminous Efficiency of Radiation

When a beam of radiation is absorbed in any way, the energy of the radiation is converted into heat. Unless there is sufficient cooling, the temperature of the object absorbing the radiation will therefore rise. Contrary to what is often implied, it makes no difference to the heating effect whether this radiation is in the infra-red, the visible or the ultra-violet regions of the spectrum. One way of looking at this is to realise that just because the human eye can see radiation of certain wavelengths, this is no reason for these wavelengths losing their heating effect. Consequently, in any projector, wherever light is absorbed, heat is generated there. All that can be done by filtering the light is to remove the unwanted radiation—those wavelengths which contribute to the heating effect without adding to the visible light—but we can never get rid of all the heat.

In the curves of Figs. 1 and 4 the heating effect may be determined by measuring the area between each curve and the base line. Comparison between the areas beneath the curves for unfiltered and filtered light shows immediately the great reduction of heating obtainable by filtering.

Another way of specifying this effect is to compare the amount of visible light (which we want) obtained from a light source, with the total amount of heat in the radiation (which we wish to reduce as much as possible). In the following experiments the visible light has been measured with an accurately calibrated visual photometer, its units being lumens. The total radiation was measured by the rate of heating of a blackened metal block, and may be conveniently expressed in watts (1 watt=0.24 calories per second). Consequently the comparison, the luminous efficiency of the radiation, will be in lumens per watt, and we want this figure to be as high as possible. Table I gives the luminous efficiency of radiation under various conditions.

TABLE I
LUMINOUS EFFICIENCY OF RADIATION

Source and Filter	*Lumens per watt*
Tungsten projector bulb, Class A1 3100°K, 500 watt, 110 volt. . .	26
Tungsten bulb (3100°K) filtered through 2mm. of ON20 heat-absorbing glass	105
Full Sunlight	80
High-intensity arc, 290 amps., 16 mm. pos.	85
H-I arc, filtered through 5 cms. water	155
H-I arc, filtered through 5 cms. water and 2 mm. ON20 glass ..	190
White light (5500°K) with no ultra-violet or infra-red (0·4—0·7 μ)	220
Yellow-green light (λ=0·55 μ) to which the eye is most sensitive	620

In this table the figure for unfiltered tungsten light is experimentally determined, and due to the inaccuracies likely to arise is only approximate. This luminous efficiency of radiation must be distinguished from the overall luminous efficiency, lumens per electrical watt, which will be somewhat lower. The 4–times improvement to tungsten light at 3100°K obtained with 2 mm. of ON20 glass may be increased to about 6 times by using 3 mm. thickness, with slightly more greenish colour.

The figure for the unfiltered arc is experimentally determined, and may be subject to some error. An attempt was made to observe only a small part of the flame above the crater. In practical terms, the luminous efficiency of the radiation from a mirror-arc projector system is only slightly higher than this, the glass of the mirror giving little filtering.

The improvements to be obtained by filtering the arc are experimentally measured and are reasonably accurate, being also supported by a considerable number of indirect experiments. A 2·2–times improvement over the open arc can be obtained. When modifying a projector by adding a heat-absorbing cell the improvement will not be quite so great.[8]

The penultimate item is the theoretical figure for the maximum luminous efficiency which could be obtained for white light (from a black-body at the optimum temperature, 5500°K), if perfect filtering of the ultra-violet and infrared could be devised.

The last item, which, of course, has no practical application to projectors, shows the absolute maximum obtainable by using light of the colour to which the eye is most sensitive.

II. HEATING OF FILM IN MOVING PROJECTORS*

We may now consider the heating of film in a moving projector. Providing allowance is made for the different gate-sizes and speeds of travel, the same argument will apply to 35 mm. and sub-standard projectors.

First, it is clearly desirable to reduce as much as possible the temperature of the metal parts of the gate, the pressure pad and film guides. This particularly helps to prevent emulsion pick-up. Spill-light and light round the edges of the aperture fall on these parts all the time, and heat is generated. It is largely the designer's concern, but much can be done by maintaining a good polish to metal surfaces so that most of the light and heat is reflected instead of being absorbed. However, some means must be provided for taking away the heat which passes into any metal part, by water-cooling or air-cooling (natural or blown) or, what is probably best where it is practical, by conduction of the heat from these small metal parts into the massive metalwork of the body of the projector. Where, on the other hand, some metal part such as a pressure pad absorbs heat and yet cannot be rigidly mounted on the main metalwork, it must be cooled in some manner to keep down its temperature. Placing the shutter between the light source and these metal parts will halve the heating effect, but cannot do more.

Measurements of Temperature

If attempts are made to measure the temperatures of such parts, it is extremely important that the measuring device be kept out of the light-beam, or it will be heated up and a false reading obtained. It should also absorb only a small quantity of heat, particularly if the part being measured is made of material with low thermal conductivity, such as fibre, plastic or glass. It is essential that good contact be maintained between the part and the measuring device. A method which could sometimes be used is to embed a thermo-couple in the part. An alternative is to run the projector for some minutes and then to turn off the light and measure very quickly the temperature of the part by means of special waxes of graded softening temperatures, or by the sense of touch. Such methods, although not particularly accurate, can reveal a great amount of information if carefully used.

Any attempt to measure the " gate temperature " directly by holding an instrument in the gate aperture is bound to fail, because the temperature reached depends primarily on the extent to which the instrument absorbs the radiation, and on the rate of losing heat from it by conducting or cooling. At best this method can only give a comparison between projectors.

Heating of Film when Exposed to Light

Secondly, and by far the more important, the film is heated in the gate by the absorption of light and heat in the silver of the emulsion, or by dyes in the case of colour film.

This problem has been solved by a theoretical investigation made by Mr. Brian S. Kellett, when with Sir Robert Watson-Watt and Partners, scientific consultants to the J. Arthur Rank Organisation, and this section of this paper is written with his co-operation. Consideration is given to a particular frame during the short time when it is in the gate.

In the darker parts of an ordinary print, almost all of the light and heat is absorbed by the silver particles, which are distributed all through the thickness of the emulsion layer, being slightly more concentrated near the outer surface of the layer, as shown in the greatly enlarged cross-sectional view of the film,

*While this paper was in the press, Dr. F. J. Kolb published work on this subject, referring particularly to film in the gate of theatre projectors. The present results, although entirely independent, are substantially in agreement with Dr. Kolb's, with the exception of the importance attributed to air cooling of film. See *J. Soc. Mot. Pic. Eng.*, Dec. 1949, p. 635.

Fig. 5. Consequently the temperature throughout the emulsion layer rises rapidly. It may be calculated that only a negligible part of the heat escapes from the emulsion to the air while the frame is in the gate, and consequently the heat flows through the emulsion layer and into the film base. Emulsion is a poor conductor of heat, and film base is even worse, which means in practice that the heat does not have time, during the brief exposure period, to travel far through the base.

The full mathematical treatment of this is complex, and the solution of the problem is given in the appendix. From this it is possible to construct the full picture of what happens within the film.

Mode of Heat Absorption

The temperatures throughout the thickness of the film at the end of the exposure period are as sketched in Fig. 5. The following points may be noted :

(i) There is a small drop in temperature through the emulsion layer.

(ii) The temperature of the emulsion is much higher than the average temperature of the base. This causes a curl or buckling of the film in the gate, as in a bi-metallic strip of a thermostat, the emulsion side curling outwards. This explains the effect photographed with an ultra-high-speed camera,[9] where it was found that the buckling occurs very shortly after the beginning of the exposure, and increases only slightly thereafter ; the objective lens has therefore to be focused back slightly towards the arc to give the best average focus.

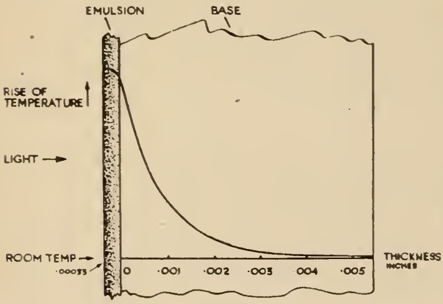

Fig. 5. Enlarged cross-sectional view of film, with graph showing distribution of temperature within the emulsion and base at end of exposing period in the gate. Only 1/1000 in. of the thickness of the base is heated significantly.

(iii) The heat travels only a very short distance into the base during the exposing period and only about 1/1000 in. of the base is heated significantly.

(iv) The rise of temperature of the far surface of the base during the exposing period is less than 1/100 that of the emulsion side of the base.

Temperatures in the Base

Due to the fact that overheating of film damages the base rather than the emulsion, by causing "embossing" of the picture area, it is necessary to consider more precisely what happens to the base, and particularly the part of the base next to the emulsion, which has already been shown to be the part which will be first damaged. Fig. 6 shows the temperature of the emulsion-side of the base during the exposing cycle. In a theatre projector the temperature rises rapidly at first as the light comes on to the particular frame considered, and then falls somewhat as the flicker-blade obscures the light—the heat is spreading deeper into the base. During the second exposing period the temperature again rises ; in the figure this part of the curve is to some extent estimated. After exposure is completed the heat now in the film (and mainly concentrated in the first thousandth of an inch of the base) spreads throughout the thickness of the base. This spreading is virtually completed about four frames after the gate (*i.e.* 4/24 of a second later) when the whole film is at about one-fifth of the maximum temperature previously reached. The whole film then very gradually cools down to room temperature after being wound up on the take-up spool.

The rise of temperature of film in a process projector is also shown in Fig. 6. There is no flicker blade, and a 200° angle of shutter opening has been assumed.

Further results arising from the theory are that it makes little difference whether the light falls on the emulsion-side or the base-side of the film ; the absorption of radiation by the base material is negligible compared with the absorption by the silver ; it makes little difference whether the silver is distributed uniformly through the emulsion layer, or concentrated to some extent near the surface ; at the end of the exposing period about one-eighth of the heat is in the emulsion and the remainder in the base. The average density of the print makes little difference—only practically full whites are significantly cooler.

Light Output from Projector

The mathematical treatment relates the rise of temperature of the film-base to the intensity of heating of the film in the gate, which may conveniently be expressed in watts per sq. cm. If then, we use the information of Part I of this paper, and know the luminous efficiency of the radiation of a particular projector, it is possible to relate the rise of temperature to the total light passing

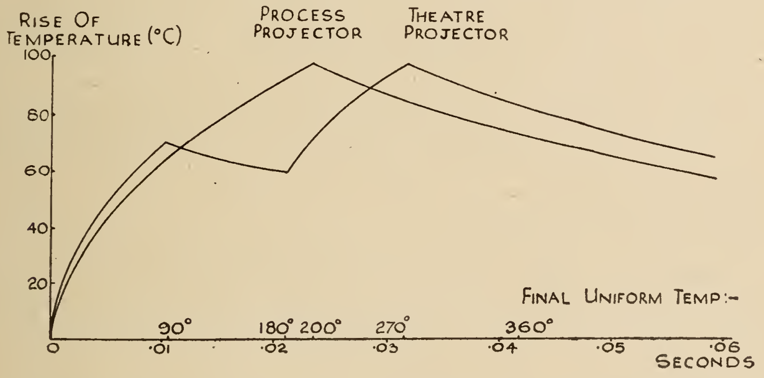

Fig. 6. The heating cycle of film while in the projector gate. The rise of temperature is calculated for the emulsion-side of the base. The maximum value reached depends on the light output.

through the gate. The total light reaching the screen will be slightly less, due to the light-loss in the objective lens.

Fig. 6 has been drawn for a temperature rise of 100°C. above room temperature. This is only an assumed maximum value, but it is of interest to note that this corresponds to a light flux at the gate of about 9,500 lumens in the case of a theatre projector. (With shutter running, intensity of radiant energy at gate 62 watts per sq. cm. ; unfiltered arc light at 95 lumens per watt ; uniform illumination over the gate.) Bearing in mind the assumptions and simplifications which have to be made in such a theoretical treatment as this, this is in remarkably close agreement with experience, and with measurements made on various projectors.[8]

It is clearly of no use to try to relate the maximum temperature which the base will withstand in the gate to the temperature at which it is damaged in some laboratory test, valuable though this may be for other purposes. For only the " skin " of the base is heated, and only for a very short time ; and, further, it would be difficult to relate " damage " as a projectionist knows it to the results of a special test.

It is the author's opinion therefore that there would be little value in measuring the temperature of the " skin " of the film base while in the gate—even if a method of doing it could be devised. Reliance must be placed instead on present experience, and in every case the results must be referred back to the intensity of heating of the radiation in the gate, expressed for example in watts per sq. cm. On this basis only can we consider how to increase the light output beyond the level at which damage now occurs.

Advantages of Filtering the Light

In Part I it has been shown that the luminous efficiency of radiation from an arc lamp can be more than doubled by quite simple filtering. In the case of a projector which is damaging film by over-heating, such a filter will almost certainly cure the trouble, while the reduction of light would be only just visible. Better results can be obtained if the filter is incorporated when the projector is being designed. It would then be possible to double the light output before damaging the film, resulting in twice the screen brightness or, alternatively, twice the area of screen at the same brightness. It may safely be asserted that there is at present no 35 mm. projector in normal use which would damage film *if only the light were well filtered.*

It is common experience that Technicolor or other colour film is not damaged by overheating in a mirror-arc projector which will damage black-and-white film. This is due to the fact that the dyes used for colour processes are nearly transparent in the infra-red region of the spectrum. Consequently the infra-red radiation from an ordinary mirror arc passes through the dyes and the film is mainly heated by the visible light. Therefore, the radiation absorbed by the film has a high luminous efficiency, as if it had been partially filtered, and the heating effect is reduced. Of course, the additional infra-red radiation which passes the film goes into the objective lens where it is partially absorbed, and this accounts for the additional heating of this lens experienced with the projection of colour films.

Present-day Process Projectors

An example of the best performance obtainable now is given by a 35 mm. process projector in which every part of the system is developed to its optimum condition. The arc operates at 300 amps with a 16 mm. positive, which gives the greatest light intensity consistent with quiet and steady burning. Any increase would result in more noise and greater unsteadiness, or would require a larger carbon with its lower surface brightness. The optical system, incorporating the combined heat-absorbing cell and first condenser lens described earlier, accepts a large proportion of the light from the arc, and this could not be increased very greatly. A relay condenser system ensures uniform illumination over the gate and the objective lenses have an aperture of $f/1{\cdot}4$. Any change to the optical system to give more light would probably result in non-uniform illumination over the screen or a reduction of definition, particularly since the defocusing effect of film-buckling in the gate might become apparent. The light output on the screen is about 50,000 lumens, and this is only a little less than the maximum amount of heat which the film will withstand, based on the curve of Fig. 6 (measured with shutter not running ; intensity of radiant energy at gate 58 watts per sq. cm. ; well filtered light at 190 lumens per watt). Since each part of this projector is pulling its full weight, it would be difficult to obtain any marked increase in output, although small increases could be made at the price of reduced silence, or less stability and uniformity of illumination or definition, if this could be tolerated in other applications. It is probable, however, that any increase of picture brightness could more easily be obtained by modification to the screens, by silvering, beading or a simple type of lenticular screen.

Future Developments

Should the need ultimately arise, it is, however, possible to foresee moving projectors with several times as much light output as those of to-day, perhaps using a " blown-arc " or large arcs and different optical systems. Looking into the future, we may tentatively consider some of the means of preventing the additional light from damaging the film, several of them being well known. In every case, of course, it will be necessary to filter the light.

(i) Using 70 mm. film would permit four times the gate area but probably only about three times as much light, since grave difficulties might be experienced with maintaining the film flat in the gate ; there would also be much disturbance to printing and processing equipment.

(ii) Running the film faster would give it less time in the gate, but reference to Fig. 6 shows that a three-times increase in speed, and therefore three-times film costs, would only permit a two-times increase of light output.

(iii) Since the rise of temperature of the rear surface of the base while being exposed is less than 1/100 of that of the emulsion side, it will be quite useless to try to reduce the over-all temperature by cooling the rear surface.

(iv) The maximum amount of heat which could be extracted from the emulsion side by forced air cooling is limited by the greatest air velocity which can be obtained. Even with a 300 m.p.h. blast of air on the film, only an extra 10 per cent. of light could be used. Air cooling of moving film is therefore worthless. A small air-jet may, however, have another use, in blowing away the steam which is formed when the small amount of water always present in gelatine is driven out by the heat.

(v) It might be possible to surround the gate with a cell with glass windows, filled with liquid, so that the film is immersed in the liquid while it is in the gate. Water is the best cooling medium, and a $2\frac{1}{2}$-times increase of light could be obtained. Due to the poor conductivity of liquids the temperature distribution through the water would be similar to that shown in Fig. 5 through the film base, except that the heat would penetrate $1\frac{1}{2}$-times as far through the water. Even so, only about 0·002 in. thickness of water is absorbing any significant amount of heat. There would be the real complication in drying the film before spooling it, even if another liquid were used.

(vi) Cooling with a rapidly moving stream of liquid would be more effective. If glass plates were placed close to the film, to form narrow channels for the cooling fluid which would be pumped through at high velocity, it might be possible to obtain about a four-times increase in the light output.

(vii) On several occasions a liquid has been applied to the picture area of the emulsion so that it is evaporated away while in the gate, some of the heat developed in the emulsion providing the latent heat of evaporation instead of heating the base. Only the liquid on the emulsion side of the film assists in preventing damage to the base. The difficulty is that the heat has to travel through the layer of liquid from the emulsion to the outer surface of the liquid, where the evaporation to the air is taking place. Due to the poor thermal conductivity, not a great deal of heat is transferred, and instead of evaporating smoothly the liquid might boil off, which might appear on the screen. A high velocity blast of air might assist in preventing this. It is estimated that a two, or perhaps four-times increase of light might be obtained.

(viii) Doubling the thickness of the emulsion would only permit a small increase of light, because such a small proportion of the heat is in the emulsion.

(ix) Because the basic difficulty arises from the poor conductivity of the film base, some improvement would result ift he thermal conductivity or thermal capacity of the base material could be significantly increased. Such a change to the base material appears most unlikely.

It may be concluded that there are several ways in which the light might be increased about four-times above the present maximum (after filtering), but each would introduce severe practical difficulties. Even by a combination of the methods at present foreseen it would hardly be possible to obtain a ten-times increase.

III. COOLING OF SLIDES IN STILL PROJECTORS

The cooling of slides in a still projector is different from film in a moving projector in that the slide has to remain exposed for a long period and the thermal conditions reach equilibrium. The heat is absorbed from the beam of light at a constant rate whatever the temperature of the slide, but as the slide warms up the efficacy of the cooling increases. After a few minutes the rate of losing heat will become the same as the rate of absorbing it, and the temperature will rise no further. This temperature must not be so high as to damage the slide.

Cooling by Natural Convection of Air

Most simple projectors rely on natural air cooling of the slide, and this method is frequently used successfully for dissipating the heat absorbed by a glass filter, such as Chance ON20 glass. The air adjacent to the glass is heated and rises, thereby causing a natural cooling draught.

In a slide the heat is mainly developed in the dense parts of the picture, but with natural cooling it travels to some extent all over the slide, the whole of it becoming hot. The maximum temperature which gelatine will withstand for 30 minutes without turning brown is about 180° C.[10] and this appears to be the limiting factor, although on some slides the glass will break before the gelatine chars.

With natural convection of air, the rate of cooling is theoretically equal to

$$0{\cdot}0004\ T^{1\cdot25}/h^{0\cdot25} \text{ watts per sq. cm.}$$ [11]

where T=temperature of slide above temperature of air (°C)
h=height of slide (cms.).

This presupposes no obstruction to the air from the slide holder, and also no cover glass ; the total area is twice the area of the slide, because heat will be lost from both sides. If a cover glass is used, the cooling will be less effective because of poor heat transfer from the emulsion to the cover glass. For cut-film sandwiched between two glasses, the cooling will be reduced still further.

Particularly in the case of glass heat-absorbing filters, which can run at a higher temperature than a slide, a significant amount of heat will also be lost by radiation :—

$$\text{Rate of cooling}=5{\cdot}7.\varepsilon.(T_1^4-T_2^4).10^{-12} \text{ watts per sq. cm.}$$

where ε=emissivity=0·9 for glass
T_1=temperature of glass (°K)
T_2=temperature of surroundings (°K).

It is found by experiment that the maximum safe intensity of heating of a 3¼ in. square slide without a cover glass is 0·25 watts per sq. cm. A glass heat-absorbing filter will withstand about one watt per sq. cm. with natural air-cooling.

Forced Air Cooling of Slides

Where a greater light output is required it is necessary to use forced cooling of the slide, air cooling being far the most convenient. A similar technique might be used to remove the heat from a glass heat-absorbing filter, or even a colour filter used in colour stage effects.

In such a system the dense parts of the picture become hot and the clear parts remain fairly cool. Heat is not conducted well from one part of the slide to another, and it is calculated, and confirmed experimentally, that if a large dark area is adjacent to a large clear area, the temperature has fallen to a third at a distance of about 0·5 cm. from the dark area. As a result of this uneven heating and consequent differential expansion, large stresses may be set up in the glass, and failure occurs by fracture of the glass, usually along the boundaries between dense and clear areas.

The slides would be less likely to break if they were made on plates of quartz or a heat-resisting glass like " Pyrex " (not a heat-*absorbing* glass). Such plates are liable to have small bubbles or blemishes and are costly, so that they would probably have to be re-used, either by transfer-sensitising them before printing, or by transferring on to them the finished print made on cut film. For studio process work it is preferred to use standard lantern plates, combined with an adequate slide cooler on the projector.

Action of the Air Stream

The action of the stream of air is shown diagrammatically in Fig. 7, blowing across a greatly enlarged view of one side of the slide. The air in contact with the slide is considered to be at rest, being " stuck " to the slide. Immediately above this " layer " is another, which " slides " on the first, and so on, layer after layer sliding on the previous one. Some distance from the slide these layers become no longer laminar and begin to become unsteady, and further still they become turbulent, eddying and swirling. This whole effect occurs within about 1/50 in. from the slide, within the " boundary layer."

Air is a very poor conductor of heat, which is therefore only to a small extent conducted through the first slow-moving " layers." Thereafter the heat is transferred with increasing effectiveness as the turbulence increases

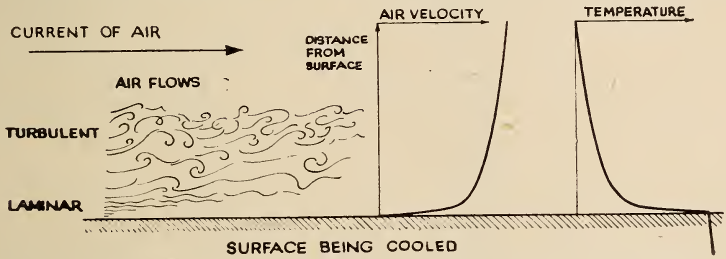

Fig. 7. The action of air in cooling a surface. Left, air flow changes from slow-moving laminar flow to rapid turbulent flow ; centre, graph showing greatly reduced velocity near the surface ; right, graph showing distribution of temperature on passing from the surface out into the air-stream. The thin boundary layer acts as a blanket over the surface.

until the heated air is mixed thoroughly into the main air stream. The distributions of velocity and temperature, on passing out into the air stream, are sketched in Fig.7.

The chief aim in forced air cooling is to reduce the effect of this slow-moving " blanket " of air over the slide, and this is mainly achieved by using a very high air-velocity. Consequently, the temperature of the main stream of air does not rise very much, and a relatively large amount of air has to be used. A great deal of data is available[11] on cooling by air within pipes, which may be of circular or rectangular section. This data may be used if a glass window is placed on each side of the slide to form a tall but thin channel, and the air is blown through this.

The rate of cooling which may be obtained with such a system is equal to :

$$\frac{3 \times V^{0.75}.\ p^{0.75}.\ C_p^{0.75}.\ K^{0.25}.\ T}{10^5\ t^{0.25}} \text{ watts per sq. cm.}$$

where V=air velocity, cm/sec.
p=density=0·001 gm./cm.^{3}
C_p=specific heat=0·24 cal./gm. °C.
K=conductivity=0·00006 cal./sec. cm.^{2} °C./cm.
T=difference in temp. of slide above air, °C.
t=thickness of each air passage, cm.

It is calculated that in such a system the emulsion side of the slide is only 10° C. hotter than the far side, so that the total area cooled is twice the area of the gate.

The important points revealed by this formula are :—

(i) The only quantity which can be varied in practice to any great extent is the velocity. Unfortunately due to the 0.75 power, to increase the cooling requires an even greater increase of air velocity, and in addition there is an upper limit to the velocity. In practice this is not the theoretical one of the speed of sound in air, but arises from the fact that at a certain velocity the slide becomes unstable and begins to vibrate. Even so, the rate of cooling could be perhaps doubled above our present limit ; and if the light output of the projector is to be increased further the size of the gate must be increased—to perhaps whole-plate size for half a million lumens.

(ii) The value of T is determined by the temperature which the slide will withstand without breaking (estimated very roughly at 150°C.) and also by the air temperature. Compared with using air at room temperature, a slight improvement might be obtained by using pre-cooled air. It is, however, difficult to arrange for the supply of a fair quantity of air at a temperature below 0°C., for the cooling equipment becomes covered in ice and frost. Rather than go to this trouble, it is considered to be far preferable to use uncooled air and increase the velocity a little.

(iii) It is some advantage to reduce the thickness of the air passages. They must not be made so small as to require too great a pressure to force the air through the slide cooler, nor to be seriously affected by the usual variations in thickness of the glass of the slide.

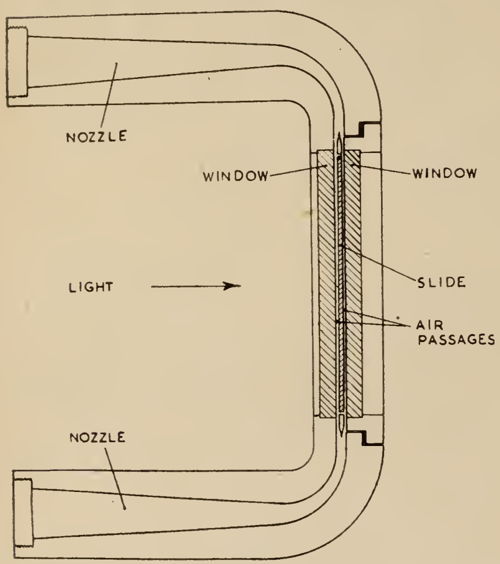

Fig. 8. Diagrammatic cross-sectioned view of slide-cooler. Glass windows close to each side of the slide form thin channels through which air is blown at a very high velocity.

Design of a Slide-Cooler

A slide-cooler embodying these principles[12] is shown diagrammatically in Fig. 8. The air is supplied at a small pressure through a nozzle which contracts in the plan view shown, and gets wider in side view until it covers the height of the slide. Another nozzle connects to an exhaust pipe, and providing it is of small angle as shown recovers much of the velocity pressure head at the slide.

The particular advantages of using the glass windows are (i) to obtain the high air velocity ; (ii) to make it uniform all over the slide ; (iii) to obtain silence ; and (iv) they probably make the boundary layer thinner. By using surface-coated optical glass for the windows the light loss is only 6 per cent. One window is fitted in a door to permit insertion of the slide, which is clamped along its upper and lower edges. Along each side-edge there is a thin metal strip to give streamlined air-flow at the leading and trailing edges of the slide.

Air Supply System

Consideration was first given to obtaining the air from an impellor pump or compressor, but it was found to be impractical to silence such machines sufficiently to permit their use on the projector, which is used unblimped and unboothed on an ordinary sound-recording stage.

The air is therefore obtained from the studio compressed air supply and the equipment is shown in Fig. 9. It was found that noise occurs wherever there is a marked drop of pressure. All the air passes at full pressure (70 lbs. per sq. in.) through the air filter, which removes water and dust. The pressure is reduced by an ordinary control valve which is surrounded with a small blimp. The extremely loud hissing sound in the air is removed by a most effective silencer, which is itself blimped. The air, now at only 2 to 6 lbs. per sq. in. pressure, passes to the slide holder and a gauge indicates the air flow. Flexible pipes are provided to enable the slide to be tilted, lifted and panned. The air becomes slightly more noisy on passing the slide at such high speed, but another silencer removes this and the air is practically silent as it exhausts into the room.

Results in Operation

This slide holder is fitted to a process projector delivering 60,000 lumens through a 3 in. × 2·2 in. gate, incorporating the heat-absorbing cell and water-cooled condenser lens described above. It is possible to project ordinary slides of any density for many hours without any damage. The equipment is so silent that it is possible to use it for all shots without troubling the sound-recording, and it is not necessary to arrange any sound reducing flats or blankets between the projector and the microphone.

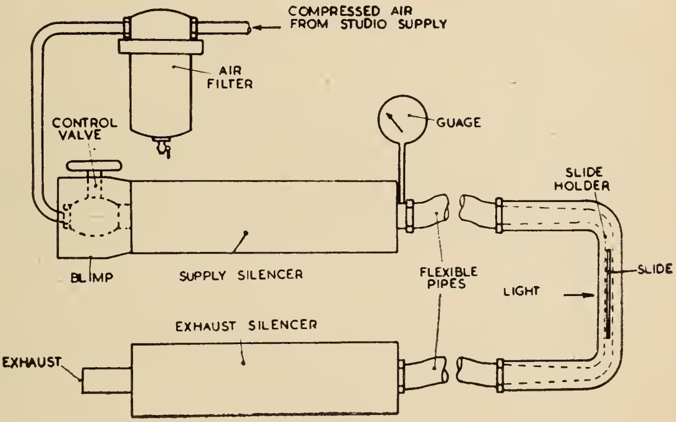

Fig. 9. Schematic diagram of arrangement for supplying air to slide cooler from studio compressed air supply. Pressure is reduced at the control valve, and silencers remove the noise.

The quantity of air used is measured to be 50 cu. ft. per min., giving a calculated air velocity about 340 m.p.h. The total amount of heat extracted from the slide is 360 watts, as measured experimentally.

Acknowledgments

Throughout this work the greatest assistance has been given by Dr. B. V. Bowden, of Sir Robert Watson-Watt & Partners, and many of the ideas and calculations are his. Help has also been given for Part I by Dr. F. S. Hawkins and Mr. H. H. W. Losty of G.E.C. Research Laboratories. The combined heat absorbing cell and lens, described in Part I, and the optical system of the high-performance process projector mentioned in Part II, were designed by Mr. A. Warmisham and his staff, and made by Taylor, Taylor & Hobson, Ltd. Facilities for practical tests have always been given by the personnel of the process projection staff at Pinewood Studios and help has been given by my colleagues in the Technical Director's Department, J. Arthur Rank Productions Ltd.

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APPENDIX

MATHEMATICAL TREATMENT OF HEATING OF FILM IN GATE

from a paper by BRIAN S. KELLETT

Fourier Method

The first step is to translate the physical problem into a form suitable for mathematical treatment. Consider a piece of film as a celluloid base of thickness d, as shown in the diagram, with an emulsion coating on the left-hand face thin in comparison with the celluloid base; this is a reasonable approximation, since the celluloid base is in fact about sixteen times as thick as the emulsion, and represents a great simplification mathematically.

Away from the edges of the film there will be no radial flow of heat and the temperature in the film base, θ, will satisfy the one-dimensional heat-flow equation: $\frac{\delta\theta}{\delta t} = K\frac{\delta^2\theta}{\delta x^2}$ where $K = \frac{k}{\rho\sigma}$, k being the thermal conductivity, ρ the density and σ the specific heat of the celluloid.

A solution is required satisfying the boundary conditions that (i) the celluloid is initially all at the same temperature, *i.e.*, $\theta = 0$ when $t=0$ for all x; (ii) heat is generated in the emulsion and flows into the celluloid at a steady rate of H calories per sq. cm. per sec., *i.e.*, $\frac{\delta\theta}{\delta x} = -\frac{H}{k}$ when $x = 0$ for all t; and (iii) no heat flows through the right-hand face, *i.e.*, $\frac{\delta\theta}{\delta x} = 0$ when $x = d$ for all t.

By Fourier's method the solution can be shown to be:

$$\theta = \frac{H}{k}\left[\frac{d}{3} - \frac{2d}{\pi^2}\sum_{r=1}^{\infty}\frac{1}{r^2}\cos\frac{r\pi x}{d}\, e^{-\frac{r^2\pi^2}{d^2}Kt}\right] - \frac{H}{k}\left(x - \frac{x^2}{2d}\right) + \frac{HK}{kd}t$$

The Fourier method depends on the fact that $e^{-m^2Kt}\cos mx$ is a solution of the differential equation. Whatever the temperature distribution in the celluloid at the end of the exposing period it can be expanded in a Fourier series of cosines of multiples of π/d. The principal term in the solution for the heat-flow after the exposing period will be a multiple of $e^{\frac{\pi^{-2}Kt}{d^2}}\cos\frac{\pi x}{d}$ and shows that the inequalities of temperature decay with a time-period of $\frac{d^2}{\pi^2 K}$, which is about 1/20 second when suitable values of the constants for celluloid are inserted.

Equally $e^{-\sqrt{\frac{\omega}{2K}}x}\sin\left(\omega t - \sqrt{\frac{\omega}{2K}}x\right)$ is a solution of the differential equation. The exposure of 1/50 second could be expanded as a Fourier series with the principal term of period 1/25 second, giving $\omega = 50\pi$, showing that heat waves are sent into the celluloid which decay exponentially, falling in amplitude to $1/e$ in a distance $\sqrt{\frac{2K}{\omega}} = \sqrt{\frac{K}{25\pi}}$

i.e., about ·0022 cms. for celluloid. The thickness of the celluloid base is roughly 6·4 times this distance so that the temperature rise on the right-hand face is about $e^{-6\cdot4} = 1/600$ times the rise at the emulsion face. The celluloid therefore behaves as if it were of infinite thickness as far as the heat-flow during the exposure period is concerned.

Due to the poor conductivity of the base and emulsion, it is also clear that during the exposing period the heat cannot spread significantly from the picture area out towards the perforated edges of the film.

Operational Calculus Solution

Having obtained this general picture of what is happening, the operational calculus readily gives a form of solution easier to use than (i) above, especially when the knowledge that the celluloid can be regarded as infinitely thick is used.

Multiplying the differential equation by e^{-pt} and integrating from $t = 0$ to ∞ gives $\frac{d^2\bar\theta}{dx^2} = \frac{p}{K}\bar\theta$ where $\bar\theta$ is the Laplace Transform of θ.

The boundary condition $\frac{\delta\theta}{\delta x} = -\frac{H}{k}$ for $x = 0$ for all t becomes $\frac{d\bar\theta}{dx} = -\frac{H}{pk}$ so that the solution is $\bar\theta = \frac{H}{pqk}e^{-qx}$ where $q^2 = p/K$

$$\text{whence } \theta = \frac{H}{k}\left[2\sqrt{\frac{Kt}{\pi}}\,e^{-\frac{x^2}{4Kt}} - x\left(1 - erf\,\frac{x}{2\sqrt{Kt}}\right)\right]$$

$$\text{where } erf\,\alpha = \frac{2}{\sqrt{\pi}}\int_0^\alpha e^{-\xi^2}\,d\xi$$

On the emulsion face $x = 0$, so that $\theta = \frac{2H}{k}\sqrt{\frac{Kt}{\pi}}$. When $t = 1/50$ sec. this gives $\theta = 7{\cdot}58H$ or $H = 0{\cdot}132\theta$.

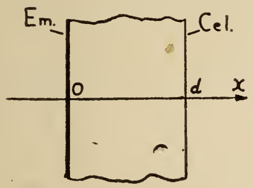


Fig. 10. Section of film with emulsion of negligible thickness.

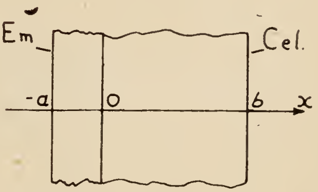


Fig. 11. Section of film with emulsion of finite thickness.

Up to this point the thermal capacity of the emulsion has been neglected. Approximate allowance can be made for this by assuming that at the end of the 1/50 sec. exposure the whole of the emulsion has risen by $\theta_{x=0}$. Inserting values for the constants shows the emulsion would therefore absorb heat at the equivalent of a mean rate of ·018θ calories/cm.^{2}/sec. throughout the exposure. This has to be added to the 0·132 θ absorbed by the celluloid to give $H = 0{\cdot}15\,\theta$ or $\theta = 6{\cdot}67H$. Given the thermal equivalent of the light incident on the film this formula shows the temperature rise on the emulsion face resulting from any incident light intensity.

In this calculation it is assumed that the emulsion absorbs all the incident radiation, and this is to all intents true for the darker parts of the picture area. Even at a density of 1·0, corresponding to a medium grey, the temperature rise is still 90 per cent. of that calculated. A full white in a normal release positive has a measured density of about 0·2, so that its temperature-rise is about 35 per cent. of the maximum.

More Refined Problem

As a check on the validity of the approximations involved in the above treatments a more refined problem has been solved. It involves regarding the film as an emulsion coating of thickness a on a celluloid base of thickness b. Light approaches from the left in Fig. 11, and is absorbed and generates heat exponentially in crossing the emulsion.

There are now two differential equations:

$$\frac{\delta^2 \theta_1}{\delta x^2} - \frac{\rho_1 \sigma_1}{k_1} \cdot \frac{\delta \theta_1}{\delta t} = - Ke^{\alpha \prime} \text{ in the emulsion}$$

and $$\frac{\delta^2 \theta_2}{\delta x^2} - \frac{\rho_2 \sigma_2}{k_2} \cdot \frac{\delta \theta_2}{\delta t} = 0 \text{ in the celluloid}$$

and the boundary conditions are:

(i) $\theta_1 = \theta_2 = 0$ for all x at $t = 0$

(ii) $\frac{\delta \theta_1}{\delta x} = 0$ or $x = -a$, $\frac{\delta \theta_2}{\delta x} = 0$ on $x = b$, for all t.

(iii) $\theta_1 = \theta_2$ and $k_1 \frac{\delta \theta_1}{\delta x} = k_2 \frac{\delta \theta_2}{\delta x}$ on $x = 0$ for all t.

These equations have been solved using the Inverse Laplace Theorem and Cauchy's Theorem to give the temperature rise in the base. The numerical result of this fuller treatment is within 2 per cent. of the result of the simpler method, thus justifying the assumption of a very thin emulsion layer.

The full solution has also been obtained for the condition in a theatre projector of the emulsion towards the arc. The numerical result is the same as before showing that the temperature rise within the base is the same to the accuracy to which the computation has been carried.

DISCUSSION

MR. H. D. WALEY: Have you worked on any of the new projector illuminants—high pressure gas arc, the zirconium arc or the high-pressure mercury arc?

THE AUTHOR: I have not made any measurements on these. High-pressure mercury discharge lamps will give a relatively high luminous efficiency, but are somewhat coloured and difficult to incorporate in an optical system.

MR. W. BUCKSTONE: Have you made measurements on the electronic flash lamp?

THE AUTHOR: No. Although these will give a brilliant flash for single exposures, the light output is limited for repeated flashing in a projector.

MR. R. H. CRICKS: Years ago experiments were made in cooling a process projector with solid CO_2.

THE AUTHOR: The extremely low temperature of solid CO_2 might be of value in certain applications if it could be used.

MR. S. A. STEVENS: In a slide projector trouble may arise from condensation on the cover glass. Sometimes the slide breaks instead of the gelatin turning brown.

THE AUTHOR: Gelatin, being a sponge-like material, can easily hold a considerable amount of water, particularly if inadequately dried after washing or exposed for long to humid air. This is driven off when the slide warms up, and may condense on the cooler cover glass. Whether a slide fails by breakage, or charring of the gelatin, depends on several factors, including the density and shape of the picture, the type of slide holder and stresses already in the glass.

MR. R. A. TOMES: It is important not to de-nature the gelatin by excessive pre-drying.

MR. C. G. HEYS-HALLETT: We have tried liquid cooling of slides by immersing them in oil. After a few seconds bubbles of gas rise from pin-holes in the slide, and then dark streams appeared on the screen, caused by refraction by the heated oil.

MR. R. ROBERTSON: How about filtering light for ordinary kinema projectors? A piece of ON20 glass without some form of cooling would stand up to an ordinary kinema arc.

THE AUTHOR: It is generally desirable to place a glass filter as far from the gate and as near the arc as possible so that the light will be least concentrated. In a kinema projector it will almost certainly be necessary to cool the glass by air blasts.

MR. B. HONRI: Some years ago I saw a device aimed at removing scratches from film, in which a liquid was applied to both sides of the film and evaporated in the gate.

THE AUTHOR: This method is extremely effective in making old scratched prints appear and sound better. The liquid on the emulsion side will contribute to cooling the film in the gate and this idea might be developed to be a significant help, if required. It also cleans oil off the film.

EXHIBITION OF FRENCH SCIENTIFIC INSTRUMENTS

An exhibition of French scientific instruments is on view until February 26 at the Science Museum, South Kensington. Among the official French organisations providing material are the National Centre of Scientific Research, the National Office for Aeronautical Studies, and the Atomic Energy Commission. Lectures are being given in connection with the exhibition and there is a bilingual catalogue of over 100 pps., price 2s.

THE APPLICATION OF MAGNETIC RECORDING TO SUB-STANDARD FILM PROJECTORS

The meeting of the B.K.S. Sub-Standard Film Division of 16th, 1949, consisted of a demonstration of magnetic sound apparatus, in conjunction with a sub-standard film projector.

K. G. Gould* and R. I. T. Falkner, A.M.Brit.I.R.E.†

IN spite of the great strides of technical development in the field of photgraphic sound recording, and its more recent and widespread usage in the 16 mm. domain, the amateur motion picture enthusiast was unable, until quite recently, to add sound to the silent films which he had produced.

The enormous interest displayed in magnetic wire and tape recording indicates that this medium of recording may prove to be the answer to a problem which was posed when sound first came to the commercial kinema—a simple and inexpensive method whereby the amateur can modernise his film making.

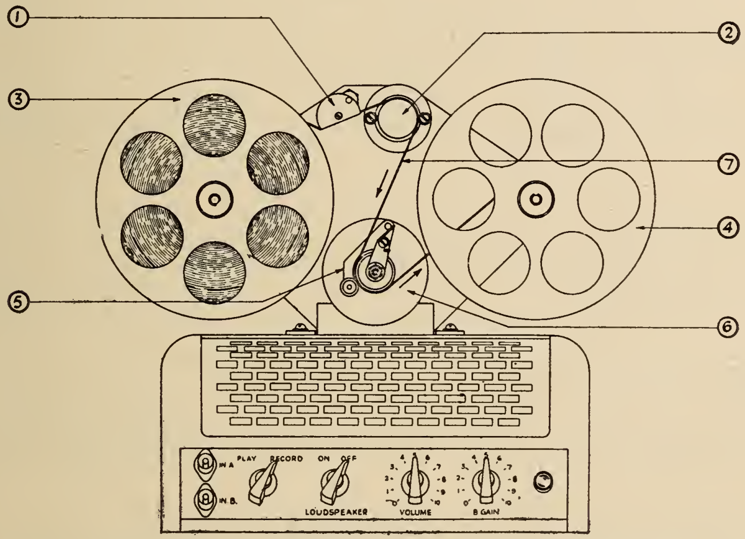


Fig .1. The Cine-Soundmaster. 1—Erase Magnet. 2—Recording-reproducing Head. 3—Take-off Reel. 4—Take-up Reel. 5—Tape Guide Roller. 6—Capstan Drive and Flywheel.

The technical aspect of magnetic recording has already been fully and capably propounded.[1]

In time, the amateur will doubtless be enabled to use his 8 mm., 9.5 mm. or 16 mm. projector as a sound recorder-cum-reproducer, using sub-standard film, embodying a magnetic track, the film being first exposed in the camera, and a commentary subsequently recorded, together with effects and music, to synchronize with the picture.

In the meantime the amateur enthusiast can achieve results somewhat similar, but with not quite the same facility, by using a separate carrier such as magnetic tape, on a recorder-reproducer driven in synchronism with his projector.

Components of Recorder-Reproducer

The Cine-Soundmaster was designed with this purpose in view. It is a magnetic tape recorder-reproducer which can be mechanically coupled to the

*Scophony-Baird, Ltd. †Formerly Scophony-Baird, Ltd.

[1] *Brit. Kine.*, 15, No. 2, Aug., 1949, p.37

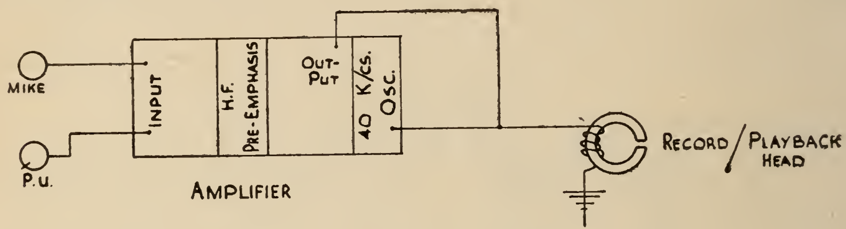
mechanism of any projector, and derives its motive power from the projector drive through a flexible coupling.

The component parts of the instrument (Fig. 1) are a take-up spool, a take-off spool, a recording-reproducing magnetic head containing the electro-magnet, a permanent magnet for erasing, and a driving capstan with its associated flywheel and mechanical filtering devices.

These parts are assembled on a mechanism plate which is mounted on top of an amplifier, the circuit of which is so designed that it serves the dual function of recording and reproducing (Fig. 2). A 40 Kc/s. oscillator provides the necessary supersonic bias current, which is mixed with the audio current in the process of recording.

Tape Characteristics

The tape used has a ¼ in. wide plastic support with a coating of gamma iron oxide. It is driven through the mechanism at three times film speed, *i.e.* approximately 15 in. per sec. with 16 mm. silent film, or 21.6 ins. per sec. if the film is run at sound speed.



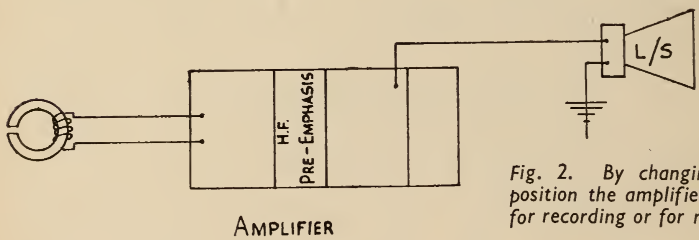


Fig. 2. By changing one switch position the amplifier may be used for recording or for reproducing.

As the tape is a third of the thickness of film stock a reel of 1200 ft. of tape is accommodated on a spool of equivalent diameter to a 400 ft. 16 mm. spool.

H.F. pre-emphasis is carried out in the amplifier circuit, and while no claim is made to high-fidelity response, satisfactory speech and musical background recordings are obtainable. The overall response characteristic of the tape and amplifier is flat within 2.5 db. between 100 c/s and 5.5 Kc/s.

The recording-reproducing head is of low impedance, and has a polepiece gap of .001 in. It is transformer coupled to the amplifier. A crystal microphone is provided, and the amplifier has an additional input which enables a gramophone pick-up to be fed in, and its signals mixed with the microphone input.

Maintaining Synchronism with Projector

Since the device is generally driven by a variable speed-projector there is no fixed tape speed, but the flexible driving shaft is always attached to a shaft on the projector which produces a speed of 1 turn per frame. This is usually available at the inching knob shaft, but in some cases modifications to the projector are necessary to obtain a suitable drive source. Satisfactory adaptations have already been made in connection with more than 30 types of 8 mm., 9.5 mm. and 16 mm. silent projectors and 16 mm. sound projectors.

After recording, the film and tape are rewound to their respective start marks and can then be run through together as a synchronised combination of picture and sound.

The mechanical load of the tape mechanism is of the order of 5 oz.-inches, and although the majority of silent projectors are driven by motors of non-constant speed, the mechanical filtering on the tape mechanism effectively eliminates flutter and wow.

Recording a Film Commentary

To record a commentary it is first necessary to get to know the film in detail, and to prepare a suitable script. A suitable means of synchronising film and tape is to place a small piece of adhesive tape on the film leader, and on the section of tape in the magnetic head.

There are two inputs to the Cine-Soundmaster, marked respectively *A* and *B*. The former is for speech, and is intended for connection to a high-impedance microphone, while the second, also of high impedance, is intended for connection to a pick-up for musical accompaniments.

The crystal microphone provided is very directional, and one has to speak fairly closely. Most recordings are done very near the projector, and such a microphone minimises the pick-up of projector noise. Each input is provided with a volume control, and that of input *B* serves as a mixer by which the music can be faded in and out. The recording may be monitored by listening to the mixed results of inputs *A* and *B* through the speaker whilst the play-record switch is switched to " record."

Editing the Track

For erasing, a permanent magnet may be put in contact with the tape ; this system facilitates editing the track. The supersonic bias on the recording head also has the effect of erasing all except the loudest passages, consequently, even if the erasing magnet is not in operation, a previous recording will be largely erased if one attempts to record over it. It is thus not possible to make separate recordings on the tape at different times.

The life of the tape is almost unlimited. Provided the tape does not enter a magnetic field it should last longer than the film itself. A section of recording has been played through no less than 10,000 times without loss of quality or amplitude. The same tape may, of course, be erased and recorded as often as desired.

DISCUSSION

MR. N. LEEVERS : In making recordings for subsequent transfer to photographic track, great care should be taken to see that the projector runs at a steady speed, and to avoid serious over-modulation ; an overloaded track raises difficulties in the transfer later.

MR. R. H. CRICKS : Where is the amateur expected to get his music from ? If he copies a disc he is infringing copyright.

MR. J. SHEPPARD : There is, when using 16 mm. film for domestic purposes, a special low rate of royalty. If you subsequently put it on to a 16 mm. film you should declare it to the Sound Film Music Bureau.

MR. P. PERCHER : Is it possible to use this equipment for wild recording by an auxiliary motor ?

MR. FALKNER : Yes, we are producing a motor specially for it. With a six-pole induction motor you will have better results than with a projector.

MR. B. HONRI : In the frequency film I was conscious of harmonic distortion due to overloading. Where was it in the system ?

MR. N. LEEVERS : Mr. Honri has raised an important technical point. Tape recorded with standard modulation at all frequencies will, on reproduction, give a response which rises by 6 db. per octave, up to a peak in the upper frequency range. This means that in reproduction, the amplifier should have a falling characteristic of 6 db. per octave up to this peak in order to equalise for the loss at low frequencies. Obviously, if the same amplifier is used for recording and playback, this rising bass characteristic has to be split equally between recording and playback processes, which means that the amplifier will have a characteristic rising at the rate of only 3 db. per octave. Therefore, overloading will take place earlier at low frequencies, and this should be guarded against.

VISUAL AND OTHER AIDS TO INSTRUCTION

H. E. Dance, A.M.I.C.E. M.B.K.S.*

Summary of a paper read to a joint meeting of the B.K.S. with the Institution of Engineering Inspection, at the Royal Society of Arts on 1st December, 1949.

EDUCATION involved the unification of ideas and it was in conveying these ideas in the best way possible that visual aids played their part. A general idea of a subject could often be conveyed more easily and quickly by pictorial methods than by verbal means, but greater preparation was required.

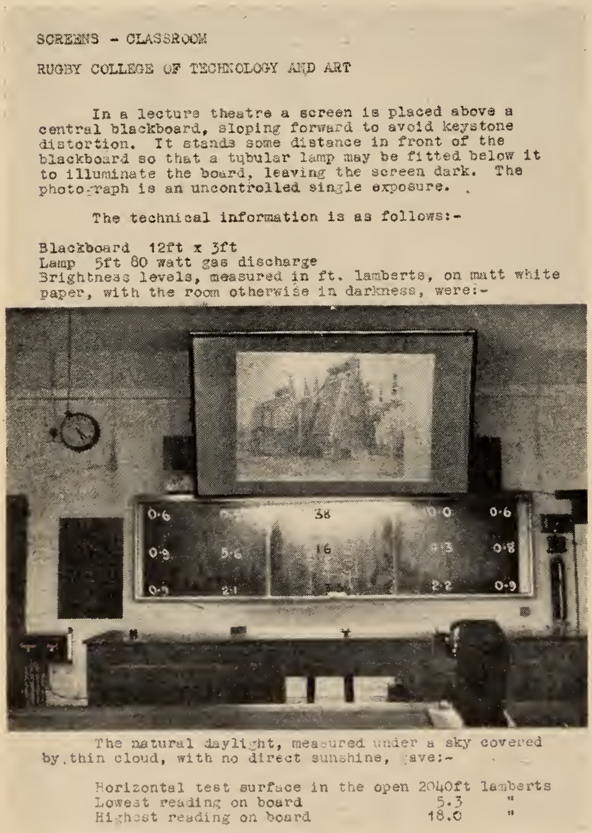
Simple Aids

Economy in all forms had to be considered in using visual aids, and accounted for the greater use of simple techniques giving less highly finished results more quickly than expensive equipment requiring a relatively long period of time to put it into operation.

But even a visual aid as simple as a chart presented a problem of storage space and easy availability. With Photopake drawings on glass any slide could quickly be made for projection, by the teacher or pupils. The most useful visual aid for the teacher was one that could be worked with little bother from his own desk.

Film-strip was cheap to make. It did not have the convenience of a book library but occupied less space. While kinematograph film evoked a great deal of interest in a class it had to be decided by the teacher whether the advantages were worth the extra cost and time involved in its use.

The author referred to the use of document film-strips as a cheap and rapid means for circulating information. The page given here, by way of example, will serve to illustrate this use of film-strip and also to show how in a technical college the projected picture and blackboard work together.


SCREENS - CLASSROOM

RUGBY COLLEGE OF TECHNOLOGY AND ART

In a lecture theatre a screen is placed above a central blackboard, sloping forward to avoid keystone distortion. It stands some distance in front of the blackboard so that a tubular lamp may be fitted below it to illuminate the board, leaving the screen dark. The photograph is an uncontrolled single exposure.

The technical information is as follows:-

Blackboard 12ft x 3ft
Lamp 5ft 80 watt gas discharge
Brightness levels, measured in ft. lamberts, on matt white paper, with the room otherwise in darkness, were:-

The natural daylight, measured under a sky covered by thin cloud, with no direct sunshine, gave:-

Horizontal test surface in the open 2040ft lamberts
Lowest reading on board 5.3 "
Highest reading on board 18.0 "

Specimen frame of Document Film Strip, used by the Ministry of Education.

A full report of this paper will appear in the Spring, 1950, *issue of the Journal of the Institution of Engineering Inspection, to be published in March.*

* Ministry of Education.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library.

THE PHYSICO—CHEMICAL BASIS OF TRICHROMATIC IMBIBITION PRINTING.
A. V. Bromberg and O. S. Maltzeva. Abridged in *Sci. et Ind. Phot.*, June, 1949, p. 232.

An extensive experimental treatment of dye-transfer printing from matrices dealing with : (1) Swelling of a gelatin layer ; (2) Dyeing the gelatin with organic dyes ; (3) Transference of dye. G. I. P. L.

HIGH INTENSITY FLASH TUBES
G. Knott, *Phot. J.*, 89B, May-June, 1949, p. 46.

HIGH SPEED FLASH TUBES AND THEIR APPLICATIONS.
A. J. Meadowcroft, *Ibid*, p. 51.

The first of these two papers describes the design factors which affect the light output and performance of electronic flash tubes. Curves show the characteristics of discharges in xenon, krypton and neon over a range of pressures and with tubes of various lengths. Data on standard tubes are given and special tubes intended for high speed photography and for stroboscopic work are described. The delay in triggering is also discussed.

In the second paper the principles of operation, and characteristics of a range of commercially available electronic flash tubes, are described. Their performance and characteristics are discussed, and photographic applications are mentioned. H. K. B.

RECENT DEVELOPMENTS IN HIGH INTENSITY VAPOUR DISCHARGE LAMPS.
E. H. Nelson, *Phot. J.*, 89B, May-June, 1949, p. 54.

This paper outlines the physical properties of a discharge in mercury vapour at high pressures and describes the development leading to the compact source lamp in which a brightness of up to 100,000 candle per sq. cm. may be obtained. The paper also describes the precautions necessary for operating mercury vapour lamps.

Highly loaded mercury vapour lamps give a reasonably good spectral distribution, particularly when cadmium is introduced into the bulb. The high power mercury cadmium compact source lamp gives good colour rendering in Technicolor. H. K. B.

THE GAS ARC—A NEW SOURCE OF LIGHT FOR PHOTOGRAPHY.
H. W. Cumming, *Phot. J.*, 89B, May-June, 1949, p. 58.

The gas arc is the name given to a discharge between two electrodes in a quartz tube filled with xenon. The tube is mounted in a jacket through which water flows to cool the lamp. The chief features of the lamp are that it will give full light output immediately after striking, and that the colour of the radiation is closely similar to that of daylight. A high voltage impulse is required to ignite the arc. As the lamp is water-cooled the heat radiation is extremely small. Its luminous efficiency, however, is only 25 to 30 L/W and its brightness is low. H. K. B.

A HIGH INTENSITY LIGHT SOURCE FOR HIGH SPEED KINEMATOGRAPHY.
E. J. G. Beeson, *Phot. J.*, 89B, May-June, 1949, p. 62.

Methods for producing the very high light intensity required for illumination in high speed kinematography are described. In one method a number of flash bulbs mounted on a disc, revolve in turn in front of a parabolic reflector and ignite as they pass through the focal position to produce a long flash. Incandescent lamp and carbon arc spotlights may also be used, although these introduce heating difficulties.

A method superior to those available hitherto consists of flashing a mercury vapour lamp at a very high overload. For example, a 1 kW. compact source mercury cadmium lamp may be flashed at 10 kW. for 1 second, 5 kW. for 2 seconds or 3 kW. for 5 seconds. The colour of the radiation from the lamp is good. The characteristics of the lamp when used in this manner are described in detail. H. K. B.

DIRECT-POSITIVE VARIABLE-DENSITY RECORDING WITH THE LIGHT VALVE.

C. R. Keith and V. Pagliarulo, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 690.

The application of supersonic A.C. bias to variable-density recording is described, and it is shown that in direct-positive recording the linearity of the toe characteristic is considerably improved, giving high output level, low distortion and good signal-to-noise ratio. N. L.

LEAD SULPHIDE PHOTOCONDUCTIVE CELLS.

S. Paksever, *Electronics*, May, 1949, p. 111.

A general description of the method of forming a light-sensitive lead sulphide layer is followed by some useful performance data in respect of spectral response, frequency response, and noise level. Comparisions with two other types of cell are made. N. L.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

NEEDS OF THE BENGAL FILM INDUSTRY

In a report submitted to the Ministry of Industries and Supply by the Bengal Motion Picture Association, it is mentioned that the industry employs 20,000 persons. In Calcutta and suburbs there are 14 studios having altogether 35 stages. Raw stock needs total 166,000,000 ft. per annum, practically all obtained from Kodak. It is stated that equipment has to be obtained from dollar sources.

Journal of the Bengal Motion Picture Association, Nov., 1949.

THE KINEMA IN NATURAL RELIEF

The " Verivision " system of stereoscopy consists in the production of films carrying right- and left-hand images, which may be differentiated by known means, as by polarised light. A feature of the system is that the stereoscopic distance in taking is varied according to the distance of the object, the stereoscopic angle being maintained at about 0.6°.

Ciné Amateur, Dec., 1949.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library

ELEMENTS OF SOUND RECORDING. John G. Frayne and Halley Wolfe. John Wiley & Sons, Inc. Chapman & Hall, Ltd. $8.50.

The progress of the advanced student specialising in sound recording has been sadly hampered by the lack of a suitable text book, and the publication of one which so admirably fills the need is an event of note. This book is compiled from the U.S. Government wartime training courses given by the authors at the University of California, suitably expanded and brought up-to-date.

The early chapters, which deal with some of the fundamentals, such as wave motions, acoustics, and mechanical systems, are written in a style and terminology which not only sets out very clearly the analagous behaviour of mechanical and electrical systems, but also leads smoothly into the consideration of specialised apparatus.

Sound transmission components such as microphones, amplifiers, filters, etc., are then dealt with, valuable information on the design and methods of use being given, in each case, and passing chapter by chapter from the general to the more specialised items such as compressors and limiters, and thence to the consideration of methods of recording. Separate chapters are devoted to systems of photographic recording, disc recording, and disc processing, and are followed by a detailed explanation of " density " and " area " techniques, methods of noise reduction, and the vital subject of film processing.

Sound reproduction is dealt with in chapters on re-recording, 35 mm. systems, 16 mm. systems, loud speakers, and acoustics. A section on magnetic recording describes basic principles and includes up-to-date information on apparatus and suitable applications of the system.

With many excellent photographs and diagrams, and the absence of serious errata, there is evidence of painstaking care in preparation. Numerical examples of calculations are given wherever these assist the explanation and there are references to other sources of information at the end of each chapter. Advanced student and professional sound engineer alike will find so much detailed information of daily use in this book, that it will certainly become a standard work of reference on sound recording.

NORMAN LEEVERS.

THE PHOTO-AMATEUR'S POCKET BOOK. Focal Press. 5s.

Although intended primarily for the amateur this little pocket book-diary is packed with information for the professional photographer and kinematographer. It is wonderful value for money and will, I am sure, be warmly welcomed.

It is difficult in a brief review to give an adequate notion of its unusual and varied contents.

Do you possess projection charts for lantern plates, film strip, 8 mm., 9.5 mm., 16 mm. and 35 mm.? Do you want to know, in all these sizes, the weight and area of film projected per minute? How do the B.S.I. logarithmic and arithmetical speed indices compare with Scheiner, Weston, or any other speed rating? How many diopters positive or negative must a supplementary lens be to cover 8 × 10 at 12-inches focus? All the answers are here and a wealth of other knowledge too.

R. J. T. Brown.

THE COUNCIL

Meeting of 4th January, 1950.

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), Rex B. Hartley (*Hon. Secretary*), M. F. Cooper, B. Honri, R. E. Pulman, H. S. Hind, R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Festival of Britain.—Mr. Cricks read letters from Mr. Wells Coates and Mr. G. W. Hart welcoming the Society's co-operation in the 1951 Festival.

Annual General Meeting.—The President's proposal that the Annual General Meeting should take place on 29th April, 1950, and in subsequent years on the first Saturday in May, was agreed. He also suggested that the Presidential Address be given then, followed by a supper and the presentation of Fellowship and Hon. Fellowship Certificates. Dates were also agreed for the despatch of nomination and ballot papers.

Premises.—The Carnegie Trust had accepted the Society as tenants of a suite of five offices at 117, Piccadilly, and the move would be made on 6th February.

Branches Committee.—The Vice-President reported on a meeting of 29th December. Mr. Pulman and Mr. Knopp had agreed to attend meetings of each Section respectively, and Mr. Knopp said he had already seen Mr. Stuart of Newcastle and Mr. Wigley, of Manchester.

Education Committee.—Mr. Cricks reported that a quorum had not assembled for a committee meeting called for 16th December. It was agreed that any decision on the question of holding instructional classes for projectionists in various centres in Great Britain should be deferred until a later date. The Council approved the establishment of a course of lectures on sensitometry, at a charge to each student of £1.

Newman Memorial Award.—Following enquiries from the R.P.S. regarding the second Newman Memorial Award, a sub-committee consisting of Messrs. Cooper, Cricks, Knopp and Wratten was appointed to consider the question.

Provincial Sections.—Messrs. Stuart and Wigley were received by Council and presented their views on provincial lectures, support from London, the *Journal*, expenses, collaboration with N.A.T.K.E., the C.E.A. and the Sub-Standard Division, representation at the Society A.G.M., and other matters. They were informed of steps being taken to overcome difficulties, and it was agreed that the Vice-President would assist Mr. Wigley in co-operating with the C.E.A.; delegates from the provinces would be welcome at the A.G.M., and a London representative would attend A.G.M.s in the provinces if invited.

EXECUTIVE COMMITTEE

Meeting of 4th January, 1950.

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), Rex B. Hartley (*Hon. Secretary*), Miss J. Poynton (*Secretary*), and Miss S. M. Barlow (*Asst. Secretary*).

Change of Premises.—An estimate was agreed for the decoration of new offices at Piccadilly and the Secretary authorised to make arrangements for the removal. New letter headings were to be printed.

Elections.—The following were elected :—

James Johnson (Member), J. Arthur Rank Organisation.

James Richard Budd (Associate), M.G.M. British Studios.

Richard Morgan (Associate), M.G.M. British Studios.

Michael Spencer (Associate), M.G.M. British Studios.

Joseph Ruttenberg (Associate), M.G.M. Studios, California.

Alfred Junge (Member), M.G.M. British Studios.

Trevor James Hawkins (Member), W. Vinten Ltd.

Frederick Arthur Geoffrey Knapman (Member), Riverside Studios.

Alfred Charles Chapman (Associate), Lanchester Properties Ltd.

Robert Verrall (Member), "This Modern Age."

Resignations.—The resignations of three Members, three Associates and one Student were accepted with regret. Others who had tendered their resignations were asked to reconsider their decisions.

COMMITTEE MEETING

Library Committee—Dec. 12, 1949.

It was agreed that any members of the Society who offered their services would be welcome to assist in the library on Monday evenings. The present system of having a member of the Committee on duty each Monday should continue, together with the associate helpers, Mr. N. Nixon and Mr. C. Bailey, who had already offered their services.

New books which had been purchased were noted, as were other accessions, and the increase in postal borrowing was regarded as satisfactory.

B.K.S. CONVENTION

The Council has decided that the annual general meetings of the Society and of the Divisions, instead of being arranged on different occasions as in the past, shall take place on the same day, together with the Presidential Address and the presentation of certificates to newly elected Fellows.

A Convention will therefore be held on Saturday, April 29, next, and in future years on the first Saturday in May. It is proposed to terminate the proceedings with an informal social event.

Further particulars will be announced next month.

INTERNATIONAL SCIENTIFIC FILM ASSOCIATION

Two members of the B.K.S. are representatives of their countries on the committee of the International Scientific Film Association. They are R. McVitie Weston, one of Great Britain's four delegates, and Jean Cleinge, of Belgium, who was in this country on a UNESCO Film Scholarship.

The work of the committee falls into two categories — research and technique. Aims of the former are :—(1) To publish an annual report on scientific research in the kinema ; (2) To prepare a catalogue of scientific films ; (3) To set up a technical research project for the kinema ; (4) To make a list of kinema specialists in all parts of the world, with a view to the possible exchange of technicians ; (5) To encourage the establishment of courses of study on kinematograph technique; (6) To organise seminars and conferences on specific subjects ; (7) To help by every means the making of research films.

STANDARDISATION AND THE KINEMA

In last month's issue (page 22) Mr. A. E. Ellis was reported as saying that he did not agree with standards being international. This was, of course, a printer's error.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

George Ashton, Keith Hornsby, Philip Jenkins and Gilbert Murray are no longer associated with the Dufaychrome process.

H. L. Bohm has been appointed a director of Dugdale Printing Ltd., printers of this ournal.

A. A. Cavalcanti has joined the Companha Cinematografia Vera Cruz, of Sao Paulo, Brazil.

F. George Gunn, after two weeks' holiday at Adelboden, Switzerland, spent a week in Paris on business for Technicolor.

Rudall C. Hayward is camera director of Associated TV Programmes Ltd., of Sydney, Australia, where he has now settled.

Anthony Hinds, producer for Exclusive Films, has become a member of the Variety Club of Great Britain, who have acquired premises in Dover Street, W.1.

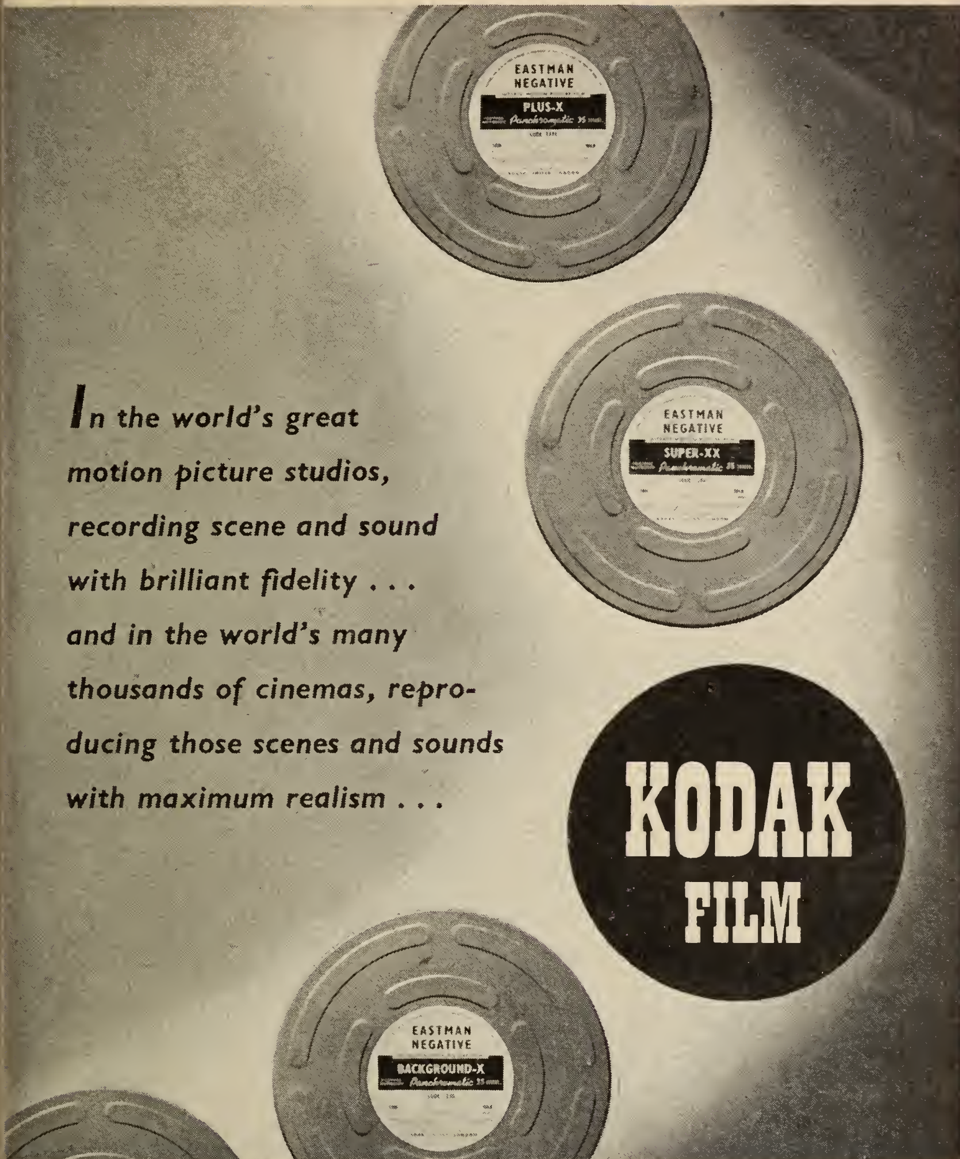
L. R. J. Johnson, who spent nearly three years with Cinema-Television Ltd., has left them to join the English Electric Co. at Stafford.

W. S. Kennedy, a student from New Zealand, who has been with the Crown Film Unit as an observer, thanks all those who have offered him assistance.

Gwen Parker thanks all those friends who have sent her messages of sympathy in her recent illness and looks forward to joining in Society activities again very soon.

J. A. S. Turner has been elected an Associate of the R.P.S.

Charles Vinten, accompanied by Eddie Gillard, is for the second time piloting his own aeroplane on a business trip to Spain and the major cities of North Africa bordering the Mediterranean.



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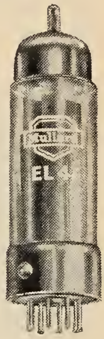

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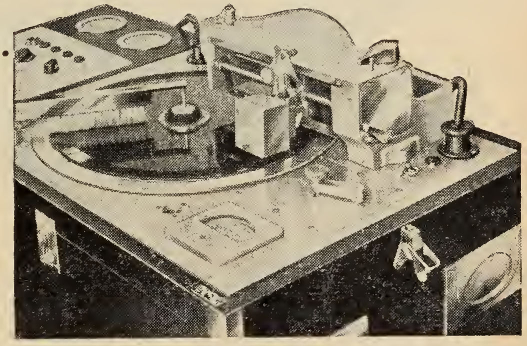

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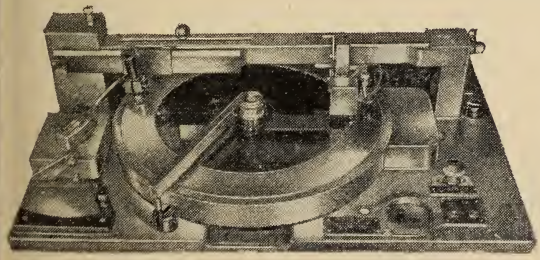

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SIXTEEN, No. 3 MARCH, 1950

ACOUSTICS AND THE FILM

Read to a joint meeting of the British Kinematograph Society and the British Sound Recording Association on 7th December, 1949

I. OPTIMUM PERIOD OF REVERBERATION

C. W. Glover, M.I.Struct.E., P.P.I.A.A.S., M.A.S.*

THE elimination of unwanted sound in a record is one of the most difficult problems with which the recordist is faced. In the case of reverberation, once this is on the record there is no method of eradicating it, although conversely it is easily possible, by means of the echo room working with two microphones, the response being mixed before recording, to add reverberation as may be necessary to the sound detected by the microphone in the studio.

As in most cases sound-on-film records are heard in a theatre with a reverberation period inherent to itself, it is obviously desirable to record the sound with the minimum amount of reverberation actually on the record.

It is true that there are occasions when for the sake of effect certain additional reverberation is required, and as already pointed out its addition to the record is comparatively easy. The present paper is confined to methods by which reverberation can be kept to the minimum in the studio.

Additive Reverberation

Owing to the fact that the reverberation inherent to the studio is permanently recorded and superimposed over the reverberation of the theatre in which the sound is reproduced, it would, therefore, be theoretically preferable to record under " open-air conditions " with no measurable reverberation in the studio. In practice this is not possible, as a certain amount of reverberation is required :—

(*a*) For the purpose of obtaining the correct tone value.

(*b*) To enable the proper sound perspective to be obtained. (This concerns the relative positions of microphone and camera during recording, and is a matter intimately connected with the particular requirements of the sequence being recorded.)

It is not possible to generalise on this subject, as considerable elasticity in the matter of studio reverberation is required.

If the studio has a period of less than one second when empty, satisfactory results can be obtained by the use of reflectors, resonators, and absorbers on the sets constructed therein.

Monitoring and Re-recording Rooms

It is in the monitor room that the tone and quality of the recorded sound

* C. W. Glover and Partners.

is analysed, and the modulation, etc., adjusted by the sound engineer so that the listener hearing the reproduced sound in the theatre receives the natural effect desired.

The acoustic condition of the monitor room (in which the sound being recorded is played over through an amplifier-loud-speaker system) should therefore approximate to that of the theatre, and a reverberation period of 1½ secs. is recommended, with a distribution of reflectors, resonators and absorbents simulating the arrangement of the theatre auditorium.

In the sound film studio assembly a small theatre is used for review and editing purposes, and the period therein should be between 1½ and 2 secs.. reflecting, resonating and absorbing surfaces being disposed as recommended for the kinema.

In the play-back studio, used, as its name suggests, for synchronisation of sound to mute sequences or any of the many dubbing processes in connection with the adjustment of sound records in sound film work, adjustable absorbents will be necessary to enable the period to be changed from ½ sec. to 2 secs. according to requirements.

Optimum Reverberation Time as affected by Frequency

It is a mistake to provide a uniform reverberation time throughout the range of frequencies. In auditoria in which the acoustics are considered

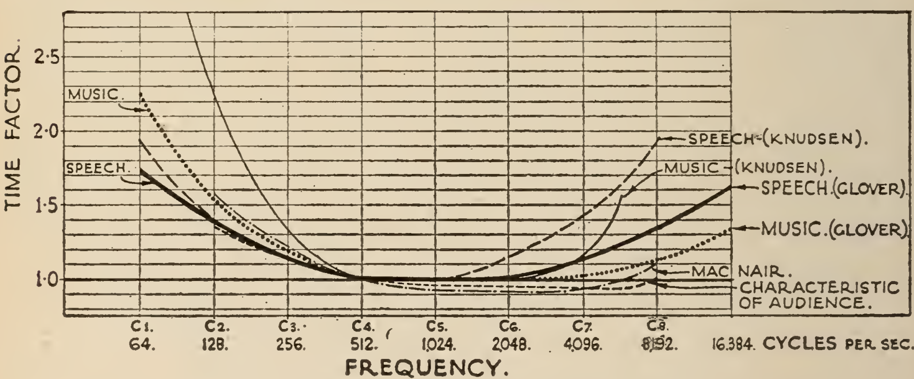

Fig. 1. Graph Showing Variation of Optimum Reverberation with Frequency. Example : If optimum for music at C4 is 1.25 secs. optimum at C2 is 1.25 × 1.55 = 1.94 secs.

ideal the reverberation is invariably greater at the lower frequencies.

Walter A. MacNair, of the Bell Telephone Laboratories, argues that it is more reasonable to specify that the loudness of all pure tones shall decay at the same rate for all frequencies, as it is the loudness which takes into consideration the ultimate appreciation of the ear. For the frequencies between 700 and 4,000 c/s., loudness and sensation-level are approximately equal, but outside this band the loudness-sensation level curve is steeper. MacNair thence deduces an optimum-frequency curve, which is reproduced in modified form in Fig. 1.

Knudsen, on the other hand, recommends a reverberation characteristic such that on the average all frequency components reach inaudibility at the same instant. His curves for speech and music are also shown in Fig. 1. It must, however, be borne in mind that the frequency distribution of sound energy to which the average audience is accustomed is influenced principally by the selective absorption characteristics of the audience and the hall. The absorption of the audience has by far the greater influence, and " the characteristic of the audience " is therefore shown on the figure.

Table of Time Factors for Optimum Reverberation

Frequency c/s.	*Multiplier Speech*	*Multiplier Music*	*Multiplier Speech and Music*
64	1.75	2.30	2.03
128	1.38	1.55	1.47
256	1.15	1.20	1.18
512	1.00	1.00	1.00
1,024	1.00	1.00	1.00
2,048	1.00	1.00	1.00
4,096	1.14	1.04	1.09
8,192	1.35	1.15	1.25
16,384	1.60	1.35	1.47

It is interesting to note that all curves indicate an increase in reverberation as desirable at the highest and lowest frequencies.

Too much reverberation at the lower frequencies causes an unnatural booming effect, whilst an increased reverberation at the higher frequencies, although desirable from the point of view of intelligibility in speech, is not desirable in music. Whenever there is a tendency for an increased reverberation in the higher frequencies, the acoustical properties of the room are regarded as unpleasant, and musicians dislike the hard tone which is imparted.

Experience seems to indicate that intermediate curves such as those indicated in heavy lines, and marked " Music " and " Speech," in Fig. 1 provide the most desirable reverberation characteristics. The " datum " of time on this figure is for 512 c/s., for which frequency the optimum time is taken as unity.

To find the optimum time at any other frequency it is only necessary to multiply by the appropriate time factor read off from the graph, or taken from the appended table.

The importance of the careful selection of absorbents to give optimum reverberation throughout the frequency range is emphasised in the tabulated results of suggested treatments for a faulty auditorium.

Although each of the suggested treatments gives optimum reverberation at 512 c/s, treatments B and C show considerable departure therefrom, at other frequencies, and the room, if treated by these methods, would be satisfactory for the soprano voice, but too reverberant for the bass, and too " dead " for the piccolo.

Table Showing Selective Absorption of Room Corrected by Treatment with :

A. 1,420 sq. ft. of Insulite.
B. 835 sq. ft. of Cotton fabric draperies (14 oz. per sq. yard) in very heavy folds.
C. 573 sq. ft. of " BB " Acousti-Celotex.

Source of Sound	Mean Frequency	Reverberation Time		
		A	B	C
Bass Voice	128	1.22 sec.	3.72 sec.	2.01 sec.
Trombone and Tenor ..	256	1.14 sec.	1.46 sec.	1.50 sec.
Clarinet and Soprano ..	512	1.00 sec.	1.00 sec.	1.00 sec.
Violin and Flute	1,024	0.85 sec.	0.64 sec.	0.95 sec.
Piccolo	2,048	0.81 sec.	0.77 sec.	0.92 sec.

Reverberation Characteristic

The recordist accustomed to working in a particular studio should have exact knowledge of the reverberation characteristics of the studio, and whilst a very great deal can be done by calculation from published absorption co-efficients of the various surfaces exposed to the impact of sound, by far the most satisfactory method is to record the decay of sound at various bands of frequencies. Fig. 3 illustrates an instrument which it would be convenient to use for such an investigation.

The instrument employs an input potentiometer and a high gain amplifier followed by a balanced rectifier. The D.C. output operates a slipping clutch mechanism which picks up forward or reverse driving movement from the periphery of a motor-driven disc and so drives the input potentiometer and recording stylus.

With no input signal there is an initial unbalance in the rectifier circuit which causes the clutch to drive the potentiometer and pen to the end of the scale where the attenuation is zero. Raising the signal level causes the clutch to operate in the reverse direction until there is a balance of current in the rectifier. The distance the potentiometer moves in restoring balance is recorded by the scriber on a moving wax paper strip and thus a measurement is made and recorded of the amount of change on the input signal.

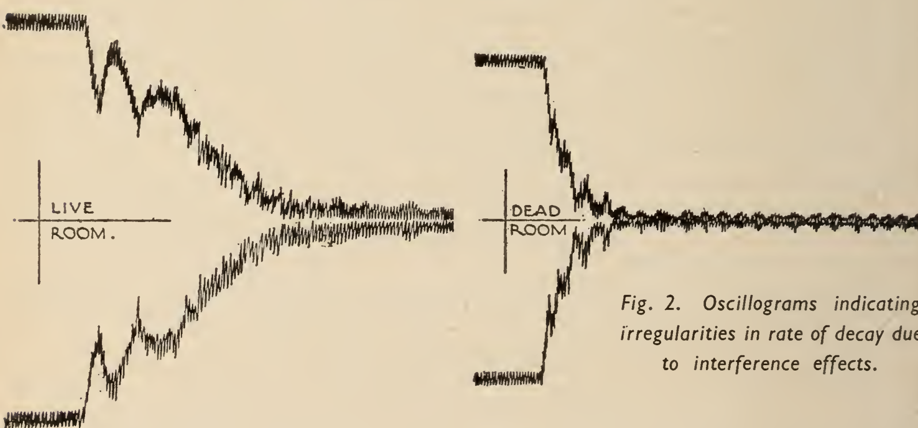

Fig. 2. Oscillograms indicating irregularities in rate of decay due to interference effects.

The acoustical properties of a room cannot be given by reverberation time alone, as the study of the oscillograms reproduced in Fig. 2 clearly indicate. These curves were obtained by connecting the output of a transmitter to an oscillograph and obtaining an actual graph of the decaying sound.

A careful examination of such graphs, obtained under various conditions, was shown by Eyring to prove that for diffuse conditions there is a steady rate of decay of sound level, but when resonators are present the decibel-time decay curve may be composed of two or more straight lines. The resonant or " live " portion of a room acts as a decaying source to a " dead " portion, hence the rate of decay of sound is changed by resonance.

The measured reverberation time only yields the " average " decay rate and takes no account of the variations in the rate within the time of decay. Too much emphasis cannot, therefore, be laid upon the importance of audiographic methods of measurement, as the results obtained therefrom afford a ready means of examining the quality of the sound in various parts of the auditorium. This is shown clearly by the oscillograph records.

The air pressure is recorded on a linear scale as vertical ordinates and the time base operated by a tuning fork on a moving strip of film. Note the echoes and the irregular rates of decay.

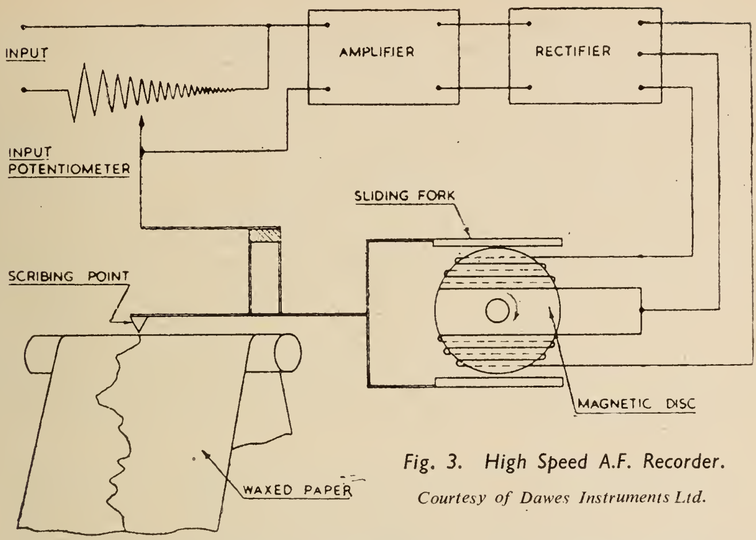

Fig. 3. High Speed A.F. Recorder.

Courtesy of Dawes Instruments Ltd.

Rooms having quite different reverberation characteristics might have the same total period of reverberation, and audiographic methods of measurement are therefore preferable to total time methods.

II. ACOUSTIC DESIGN OF STUDIOS

John McLaren, B.Sc., A.M.I.C.E.*

THE problem of the recording studio, which can be used either for broadcasting purposes, for gramophone recording or in film work for the post-recording of sounds or music, will now be considered. The type of studio is the same or similar in each case.

What is acoustics? A fair definition would be that it is the scenery of sound. To take an analogy from photography, a portrait may be taken of a person, and by the use of a suitable background and by the proper arrangements of the lights, an experienced photographer can make a satisfactory and pleasing portrait. A distracting background and hard lighting will cause the portrayal of the subject to be confusing ; a neutral background and soft diffused lighting will produce an uninteresting photograph. We can apply this analogy to acoustics, in this sense : the first example is like an orchestra playing in a hall which has too long a reverberation time and also suffers from echo and dead spots ; the second example is like an orchestra playing in a hall which is so festooned with heavy drapings that the reverberation time is almost zero.

It is, therefore, the object of the acoustical designer to plan a hall or studio so that its reverberation time and its reverberative effect form a setting which shall show off the performance of the players (in the case of an orchestra) to its best advantage.

Physical and Psychological Measurement

As in photography it is the eye that decides the artistic merit or otherwise of a photograph, so it is the ear that decides the acoustic merit or otherwise of a studio or concert hall. The importance of this point cannot be overstressed, because in these days when there are instruments which can measure almost everything, there is a tendency to become " meter-minded," and to think that if a measurement conforms to a certain pre-conceived standard, then all is well. Nothing could be farther from the truth ; a meter can only

* C. W. Glover and Partners.

measure some particular physical effect, and it would require a host of meters to measure all the physical effects which go to make up a psychological effect —and then the answer would probably be wrong !

The term " reverberative effect " must not be, though it very often is, confused with reverberation time. Reverberation time is the time taken for a sound to die away, and the reverberative effect is the manner in which it does it. To take an example, consider a large room, the lower half of whose walls are covered with highly glazed tiles and the upper half with a six-inch layer of rock wool, which covering is also placed on the ceiling. If one were to enter such a room, the first sounds that would reach the ear would be the many sound reflections circulating in the lower half, whilst overhead would be felt a sort of oppressive heaviness. If now the treatment be reversed and the rock wool be situated in the lower half, and a heavy pile carpet be placed on the floor, whilst the upper half and the ceiling were tiled, then one would be greeted with a sombre heaviness on entering the room, accompanied by an overhead murmuring caused by such sounds that have escaped absorption in

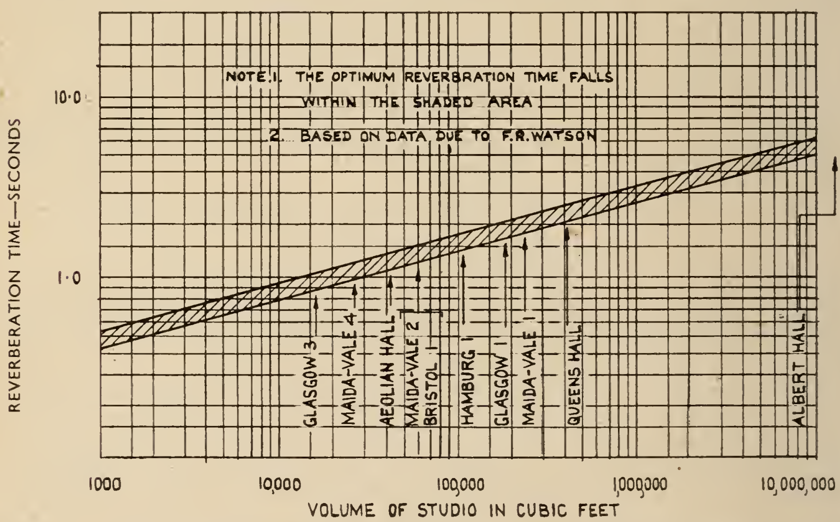

Fig. 4. Optimum reverberation time as a function of studio volume.

the lower half. In no way could it be said that the acoustics of the two rooms are the same, nevertheless, it is most probable that if the reverberation times of the two rooms were measured they would be substantially the same.

Comparative Sound Treatment

Such a difference was discovered in a pair of studios at the Maida Vale premises of the British Broadcasting Corporation, which were deliberately made of identical volume and of the same mean internal dimensions. The difference between them was that one of the studios had the walls and ceiling broken up with bold, zig-zag corrugations while the other had plane walls. The acoustical treatment consisted of covering substantially the whole of the wall surfaces with $\frac{1}{2}$ in. building board, and the floor with a carpet laid on building board over the concrete floor.

The reverberation time of the two studios, when measured, was found to be substantially the same, but the reverberative effect was quite different, the studio with the broken up walls and ceiling appearing to the ear to be much less reverberant than that with the plain walls.

At the time when these experiments were carried out, the technique of measurement was not sufficiently advanced to detect appreciable variations of the decay curves at each frequency, but it is felt that with modern methods, which include pulse measurement which gives a critical analysis of the decay of sound in a room, valuable information could have been obtained.

Having established the two factors which form the basis of good acoustical design, the next point is to determine how these effects are to be obtained. As is well known, the reverberation time is controlled by the amount of absorption, either inherent in the structure or deliberately added, that is present in the studio ; the reverberative effect is obtained by the position in which the added sound absorbing material is placed in the room, by the shape of the room and by profile of the surfaces.

Reverberation Frequency Characteristic

Let us first of all consider the problem of obtaining the correct reverberation time in the studio ; what should be the optimum reverberation time for a given

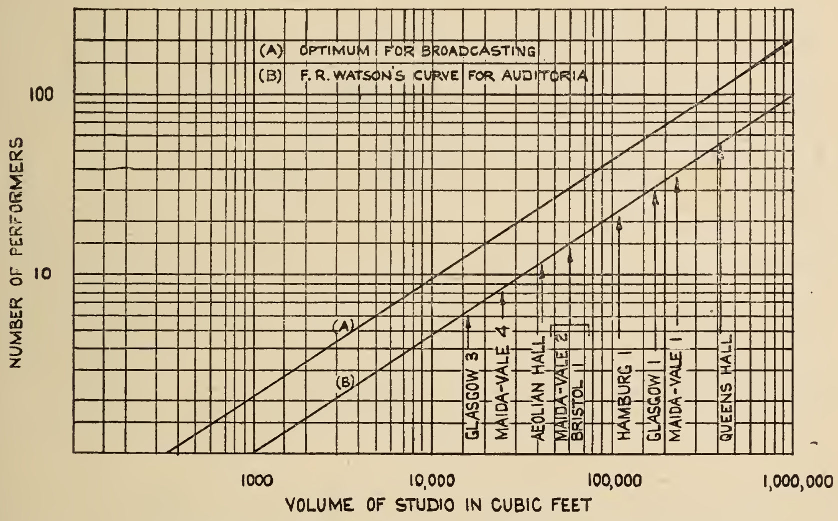

Fig. 5. Maximum number of performers as a function of studio volume.

size, and what should be the shape of the reverberation time-frequency characteristic ? F. R. Watson, who was a contemporary of W. C. Sabine, calculated a curve of optimum reverberation time for various sizes of halls, taken from places which were considered to be good acoustically, and the B.B.C. have adopted and modified this curve to meet the requirements of broadcasting. This curve is shown in Fig. 4, and marked against it are the names of some studios and well-known concert halls.

In conjunction with this curve is another, Fig. 5, also based on the work of F. R. Watson, which indicates the optimum number of performers which should be used in a studio of given volume. Hence, by the use of these two curves, the required size of studio and its optimum reverberation time can be determined.

The next point that requires our attention is the shape of the reverberation time-frequency characteristic. About this subject there are several opinions, but generally speaking the opinion held in the B.B.C. is that the curve should be flat, but that a *slight* increase of reverberation time at the low frequency end of the scale is not objectionable in studios intended for music. At the high frequency end it is not practicable to maintain a straight line curve owing to the effect of absorption by the air.

Resonant Absorption

Having now laid down our requirements, the next step is to ascertain how to obtain them. It is necessary, in almost every case, to add sound absorbing material in order to bring the reverberation time of the studio to the required value, and for this purpose the usual porous absorbents such as rock wool, glass silk, Acousti-Celotex tiles, and the like are satisfactory for the frequencies above 500 c/s. On account of the rapid falling off of the co-efficient of absorption of these materials for frequencies below 500 c/s, some other method of absorption in this lower frequency band must be employed. The most simple method of obtaining absorption in the lower frequency range is to make use of resonant absorption. It is fortunate that in most buildings there exists a considerable degree of resonant absorption, in such elements as floors and ceilings. This property will be illustrated more fully later.

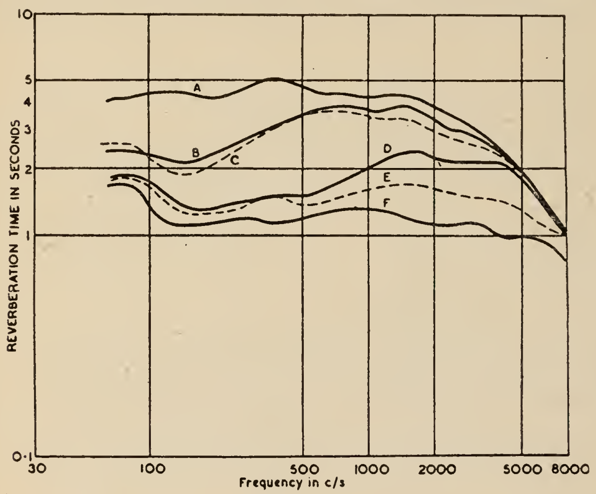

Fig. 6. B.B.C. Studio No. 2, Maida Vale. Change of reverberation characteristic with progress of acoustic treatment.

Briefly, the principle of resonant absorption is that, for example, a wood panel, which is supported at its edges, and possesses mass, elasticity and internal resistance, forms a resonant circuit. How flat the resonant curve is depends on the internal resistance of the material. When a sound wave, at or in the region of the resonant frequency of the panel, strikes it, it is caused to vibrate ; energy is absorbed and is dissipated in the internal resistance of the panel, and hence the sound energy in the room is reduced in a similar manner to that when a sound of higher frequency strikes a porous absorbent. The subject is not as simple as has just been described, and actually is rather complex, but time does not permit of delving more deeply into all the factors involved.

Investigation of Acoustic Treatment

When the studio with the corrugated walls, which has been previously mentioned, was due for retreatment, the opportunity was taken to find out the behaviour of the various elements, and to do so, the retreatment was carried out in a piecemeal manner. The studio was first stripped of the existing treatment, leaving only the bare plastered walls, the screeded concrete floor and the lath and plaster ceiling. A reverberation curve was then taken and this has been reproduced in Fig. 6, curve A. It will be seen that the curve is substantially flat between about 60 and 2,000 c/s, but that the reverberation time is excessive ; the optimum value for a studio of this size is about $1\frac{1}{2}$ seconds.

The fact that the curve is flat indicates that the ceiling must be contributing very greatly in absorption, particularly in the lower frequency range. Were this not so, then the reverberation time at the lower frequencies would have risen to a much greater value. The steady fall in reverberation time at frequencies above 2,000 c/s is due partly to surface absorption and partly to that caused by the air.

The next stage in the re-treatment consisted in laying a floor of oak strip 3 in. wide supported on battens, fixed to the concrete structural floor. The curve B shows the reverberation time after this operation. It will be seen that the floor contributes a very considerable degree of low frequency absorption. The addition of the wood panelling and a certain amount of lath-and-plaster work contributed a small amount of absorption, which is indicated in curve C. The wood panelling, although adding considerably less absorption than had been expected, plays a useful part in adding to the brightness of musical tone by giving strong first reflections. The porous absorbent was then added; this consisted of wall panels and a frieze of 2-in. rock wool covered with perforated asbestos tiles, the perforations being about $\frac{1}{8}$-in. in diameter and spaced at about 1-in. centres. About one-fifth of the wall surface was treated in this manner. The effect is shown in curve D. The rise in reverberation time above 500 c/s was unexpected, and it is now considered that it is caused by the diameter, thickness and spacing of the holes in the asbestos tiling.

To counteract this rise in reverberation time, a suitable quantity of $\frac{1}{4}$-in. felt, covered with cribble cloth which is a perforated American cloth, was applied to the ceiling. The acoustical effect is shown in curve E. It will be noted that the thin felt had negligible absorption for frequencies below 500 c/s. The slight rise in reverberation time, which has a peak value at about 1,500 c/s, was found to be undesirable in practice, and this was corrected by hanging light casement cloth curtains over the rock wool panels.

The final reverberation curve is shown in curve F. Owing to wartime conditions, this last curve was not taken until 1945, hence the differences from the previous curve may be due to other causes than the addition of curtains. The information given by this series of experiments and other information obtained from experimental work carried out in the past provided valuable practical data in the design of broadcasting studios.

Shape and Profile of Studio

So far little mention has been made concerning the shape of the studio or of the profile of its interior. There has been a great deal of discussion and argument on this subject, and all that can be reasonably said is that so far, there is no conclusive evidence that parallel walls are better than non-parallel walls, or that one type of breaking up of the wall surface is better than another. It can be said, rather facetiously, perhaps, that the continent of Europe and the United States of America are littered with the corpses of acoustical fads and fancies which have been tried and found wanting! To take as an example the much vaunted polycylindrical treatment, which was so popular a few years back, in the form of a band shell. This type of treatment was used by Walt Disney for the recording of his fine film, "Fantasia," and it gave a very good result, but further experience in this type of treatment has shown that for general use too much diffusion of the sound was obtained.

In order to investigate the differences between plane parallel walls and those treated with hemi-cylindrical treatment, a graphical study was made by the Research Department of the British Broadcasting Corporation. In order to reduce the problem to its simplest terms, only two dimensions were considered and furthermore the study was confined to the first reflections only.

The results showed that in the case of the plain walls there were four strong reflections which arrived to a listener at intervals after he heard the original sound, and in the latter case, there was a very large number of low-intensity reflections arriving after a strong direct sound. Neither effect is entirely desirable, the latter tending to provide a colourless studio without character, whilst the former one which may be harsh and "echoey." The answer probably is to effect a compromise between these two extremes. Such a design was carried out just after the war in the retreatment of another of the Maida Vale musical studios, No. 5, whose volume is of 26,000 cu. ft. in which the upper surface of the long walls has been broken up by vertical architectural features and in the short walls by horizontal features. The lower portions of the walls up to door height are panelled in half-inch plywood.

The acoustical treatment is carried out in Acousti-Celotex tiles, and has been graduated so that the maximum area of absorbent tile is at the end of the studio remote from the players. The wall space not occupied by the tiles is filled up with quarter-inch plywood mounted on battens at about one-foot centres. This panelling provides resonant absorption in the region between 200 and 300 c/s. The reverberation curve is very flat, having a mean reverberation time of approximately 0.8 seconds. It has proved itself very satisfactory in practice, when used for the purpose for which it was designed, namely for small musical combinations of up to about 20 players.

DISCUSSION

Mr. Baynham Honri: Years ago the B.B.C. experimented with a wallpaper on top of felt as a treatment for studios.

Mr. W. S. Bland: In broadcast work or gramophone recording, people listen at home; in film work we project sound into a large place with reverberation time of a very high order. The problems in designing a recording enclosure for the original recording are quite different.

Mr. McLaren: It is the practice of the B.B.C. to try to have monitoring rooms and control cubicles the same size and with the same conditions as in an ordinary living room. Measurements have been made in people's houses and the reverberation period is of the order of half a second.

Dr. L. E. C. Hughes: Since I did some research on the magnitude of the disturbance of the steady sound-field in 1928, I have always advocated the quasi-optical examination of proposed structures for the conservation of sound-power. Strong reflections should be eliminated and there should be no parallel walls. Such acoustic conditions, and particularly low reverberation times, conflict with the requirements of artistes. The engineer in placing his microphone must make the best compromise; the answer at one time was the "live-end dead-end" studio, the live-end being shaped so that the artistes get strong short-delayed reflections, while the dead-end is so treated that there are no strong reflections arriving at the microphone from any non-axial direction. The polycylindrical surfaces now in fashion disperse the reflected sound-waves through increased solid angles, and also effectively bring local reflections nearer the surface for the benefit of "contact" among a group of artistes. Unfortunately, the acoustic refinements suitable for music conflict with those for speech, necessitating compromises which degrade both.

The correctly designed kinema is really an extension of the loudspeaker loading behind the screen. All other schemes are makeshifts, but sometimes they can be good acoustically.

Mr Glover: Long before the diffuse cylinders were discussed I had to find an expedient in dealing with the De La Warr pavilion at Bexhill. The acoustic reflection from the flat surface of the ceiling follows optical laws and the acoustical image is as far behind the reflector as the original source is in front of it. In order to avoid that I put in a number of small domes over the ceiling. Instead of getting reflection from a second source each little dome acted as a real image would in optics, and we had a series of separate sources at the ceiling level rather than some hundred feet behind it.

Mr. Ross: On the measurement of reverberation time, was a pure or warble tone used and at what frequency?

Mr. Glover: You can use a warble tone with advantage with a modulation of ± 10 per cent. and at 5-10 c/s.

Mr. McLaren: The reverberation times of studio and listening room are not necessarily additive—one curve sometimes masks the other.

Dr. L. E. C. Hughes: The equivalent reverberation of two reverberations in series is a difficult calculation and is not continuous.* Solutions are possible when the two reverberations are equal, or when either is more than 1.5 times the other.

* E. A. Johnson, *J. Maths and Physics, M.I.T.*, 9, 1930.

PROGRESS REPORT ON COLOUR KINEMATOGRAPHY

Jack H. Coote, M.B.K.S., F.R.P.S.*

Read to a joint meeting of the British Kinematograph Society and the Association of Cinema and Allied Technicians on 30th November, 1949

THIS progress report on colour kinematography[1] must necessarily suffer from certain omissions and possibly some errors. For obvious reasons, it is very difficult for anyone to prepare a comprehensive and unbiased report when he is himself concerned with a particular process.

Figure 1 is a chart showing the processes which are in use to-day and their relationship to each other. The chart refers only to three-colour processes, and only to processes which are known to be commercially available.

I. THREE-STRIP PROCESSES

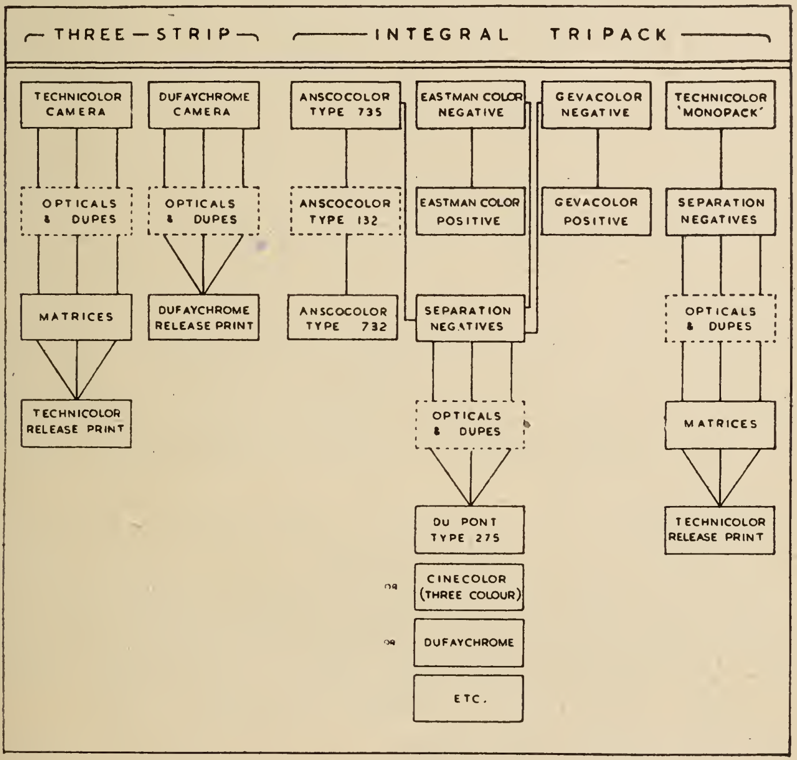

Fig. 1. Chart of three-colour processes in use to-day.

Appropriately, the chart commences with Technicolor under the section headed " Three Strip." Since it has often been said that the extremely efficient Technicolor organisation is " all strings and mirrors," one can only guess at the direction of any progress they are making with their processes.

The increases in the price of silver during recent years have made it more than ever desirable that Technicolor should commence their train of operations

* Dufay-Chromex Ltd.

with a simple gelatine-coated film rather than with an emulsion-coated material. The principal reason for starting with a silver-halide emulsion is to produce a silver image sound track, although it also appears to be the practice at present to print the frame margins at the same time as the track, and to process both of them before the transfer of the three component dye images.

Technicolor Sound Track

Much thought and several patents have been devoted to the possibility of producing a sound track by dye-transfer from a matrix in the same way as the picture images are formed ; but even Technicolor do not seem to have been able to overcome the difficulties in reproducing sound from a dye image track—particularly when such a track must suffer from some diffusion.

The latest line of approach seems to be to form a track of an insoluble iron salt, which is known from experience with two-colour processes to be substantially opaque to infra-red rays and therefore satisfactory for sound reproduction with normal photo-cells.

One of the proposed procedures is to sensitise locally the track area of a gelatine-coated blank film with ferric ammonium oxalate before seating it on the usual type of imbibition pin-belt ; and then, after application of a matrix bearing yellow-dyed gelatine relief images, in both sound and picture areas, to expose the light sensitive area of the blank film through the dyed sound track image of the matrix. When the blank and matrix have been in contact long enough for the dye to have transferred, the two films are parted, the matrix being wound up ready for further use and the blank continuing into a bath of potassium or sodium ferricyanide for the development of the printed sound track image. After treatment in the ferricyanide bath, the blank is washed to remove the soluble unexposed iron salts from the track area and then dried before returning to the pin-belt to receive the magenta and cyan component images.[2]

The procedure involved in making 35 mm. Technicolor release prints from 16 mm. Kodachrome originals is obviously much the same as that required when working from so-called " Technicolor Monopack." Whereas the supply of 35 mm. " Monopack " was restricted at one time, 16 mm. Kodachrome has been freely available in America for many years, yet so far as I know no 35 mm. release printing laboratory, other than Technicolor, has ever made successful use of the fact.

Dufaychrome Cameras

Dufaychrome is next on the chart—a process about which I could say much, but about which I propose to say very little.

We have now completed two three-strip cameras,[3] and have four more in hand—in fact the combined total of Technicolor and Dufaychrome three-strip cameras now being built in this country must constitute a record in the history of colour kinematography. Certainly there is no indication that the " beam-splitter " camera will be relegated to the museum shelf.

II. INTEGRAL TRIPACK PROCESSES

Next in line on the chart are the integral tripack processes, and the first of these in alphabetical order is Anscocolor.[4] I had hoped to be able to project a recent example of Anscocolor printed from Type 735 camera film, but although I asked Denham Laboratories they have been unable to help me. It certainly would have been interesting to have seen something of either "Alice in Wonderland " or " The Man in the Eiffel Tower."

A recent paper by Bates and Runyon[5] shows that the Ansco technicians have gone deeply into the theory and practice of their process. This paper deals much more fully with the control problems involved in processing a multi-layer colour material than any information obtained from Germany.

Anscocolor Processing

The authors commence with the plain but all-important statement that: "The continuous processing of Anscocolor film requires control of speed, gradation, fog, maximum density, and other variables common to the processing of black-and-white film, but with the complicating factor that the variables must be kept constant in each of three superimposed emulsion layers." They go on to say that three general control methods, photographic, analytical and *p*H, are recommended for the various testing operations.

Both the first developer and the colour developer are replenished at a high rate, the first in order to avoid accumulation of bromide, and the colour developer because the replenisher is used at the maximum practical concentration. Bromide is added to the colour developer replenisher because it accumulates too slowly as the result of reduction of silver. Short-stop and hardener baths are both replenished at a high rate to prevent their contamination by carry-over of preceding solutions. The bleach is not replenished, but is regenerated when necessary by means of liquid bromine. Two bleach baths are required, one remaining in use while the other is being regenerated. The fixer is used until it is sufficiently exhausted and is then dumped for silver recovery by the sulphide method—electrolytic methods being unsatisfactory for neutral or alkaline fixing baths.

Control of Anscocolor

It is interesting to note that Ansco consider it necessary to construct a special control test machine in order to obtain reproducibility better than the tolerance allowed for the solution or material being tested. In other words, it is necessary to be able to process strips so that the results will not deviate by more than one-eighth stop in speed or one-sixteenth stop in colour balance when identical solutions are used for the reference and the sample.

In discussing the permissible fluctuations during continuous processing, Bates and Runyon point out that the variables which cannot be absolutely controlled include differences in emulsion batches, printer exposures, chemicals, solution mixes, developing times and temperatures, circulation rates, drying conditions and even final densitometry. In practice, although the deviation due to any single one of these influences may not be serious, from time to time the additive deviation will amount to as much as plus or minus one-quarter stop in speed as well as one-eighth stop shift in colour balance.

Leaving aside the preliminary testing of chemicals, raw materials and processing solution mixes, there are more than twenty regular tests required to be made at various intervals during processing. These tests include hourly checks on temperature and *p*H of both first and colour developer, as well as analyses of both for bromide every 4 hours, and for all ingredients every 2 days. The densitometry of any colour film involves the use of quite special measuring instruments, and for their work Ansco have undoubtedly employed the electronic colour densitometer designed by Sweet.[6]

It is to be hoped that either Ansco or some laboratory regularly using Anscocolor will shortly deal with the control of the printing operation in an equally detailed manner.

Eastman Color Negative

The next integral tripack on the chart has not yet reached us in this country, in fact Eastman Color Negative stock is probably not yet generally available in America, although test rolls have been issued to most of the important laboratories. This eagerly awaited product of the Eastman Kodak Laboratories is the motion picture version of the cut film material known as Ektacolor, which is a material capable of forming its own masking images during colour development—the masking images being designed to compensate for the deficiencies of the dyes which comprise the colour negative image.

Instead of absorbing only in the primary colour bands red, green or blue, the best available dyes formed from colour couplers also absorb light of one or both of the colours they should freely transmit. Generally speaking, magentas and cyans are the least perfect, while yellows are usually fairly satisfactory. Most magentas absorb green light as they should, but also absorb some of the blue light they should transmit ; while cyan dyes usually absorb some blue and green as well as the red they are intended to absorb.

In Eastman Color Negative film, the undesirable blue absorption of the magenta dye is compensated by the provision of a correction mask which is coloured yellow, while the unwanted blue and green absorptions of the cyan dye are compensated by means of a mask which is coloured orange-red. These yellow and orange-red masking images are formed within the appropriate image layers of the film in an entirely automatic manner during the normal process of colour development.

Automatic Colour-Masking

Like any other multi-layer negative material, Eastman Color Negative comprises emulsion layers sensitive to red, green and blue, and incorporated in these layers are cyan, magenta and yellow couplers, the first two of which are themselves coloured at the time of incorporation in the emulsions. The cyan coupler is orange-red in colour while the magenta coupler is yellow.

After exposure and colour development, three silver images are formed in the film, as well as three corresponding dye images. After removal of the reduced silver and remaining halides, the negative dye images will remain, *together with the unused couplers* in the three layers. In all other colour film using couplers, care has been taken to ensure that the residual couplers which remain after processing are transparent and colourless, but in Eastman Color Negative the original colours of the cyan and magenta couplers are not changed or destroyed when the developed colour images are formed, and the remaining, unused couplers comprise positive images which have been utilised to form the required colour correction masks.

Whenever there is a magenta image density, there is also an unwanted yellow density accompanying it by reason of the unwanted absorption of the magenta dye itself. Where there is a maximum density of magenta there we shall also have a maximum density of unwanted yellow, and no additional yellow due to coloured coupler. The density of the yellow-coloured coupler layer is so calculated that the unwanted yellow density is just matched by the yellow due to the coloured coupler in areas where no silver is reduced. Where there is less than a maximum density of magenta, then there the whole of the yellow-coloured coupler will not have been used and the residue will add just sufficient yellow density to make the same overall total.

It will now be evident that this uniform yellow density, which is continuous throughout the magenta image layer, will cancel the effect of the unwanted yellow component of the magenta image, and only density due to the true magenta component of the image will modulate light transmitted by the layer. The same principle is employed in masking the cyan image, but an orange-red coloured coupler is used because the cyan dye is responsible for unwanted absorption of both blue and green light.

In case I have not succeeded in making the matter clear let me present the idea in the words of one of the patents which protect it :—[7]

> "A method of producing a colour corrected colour component record for subtractive colour photography, in which an image constituting the record is developed to the required subtractive colour in a silver salt emulsion containing a colour coupler which gives such subtractive colour on coupling development, but is itself so coloured, that it absorbs light undesirably absorbed by said subtractive colour, whereby the uncoupled colour coupler forms the complementary image required for masking."

Eastman Color Positive

A straightforward non-masked multi-layer material to be known as Eastman Color Positive will be used to obtain prints from Eastman Color Negative originals. I cannot show you a specimen of this new process, although I can report on a demonstration of it which I saw in Rochester early this year. The accuracy and saturation of colour seemed to me to be better than any other negative-positive multi-layer process I have seen, but the definition was not as good as with Anscocolor or Agfacolor. The storage characteristics of the negative material were not good, and although it may have been improved by now, it is likely that the material will need refrigerated vault space.

While there is no doubt at all that Eastman Color Negative represents an important advance in colour kinematography, and little doubt that it will produce better colour prints than unmasked colour negatives, no one I met at Rochester suggested that satisfactory quality could be retained throughout duplicating operations. When this aspect of the situation arose, it was agreed that three-strip negatives provided the only satisfactory answer.

Gevacolor Process

The Gevacolor negative-positive process, the last of the integral tripacks included on the chart, is not yet in commercial use in England, and for this reason I have been unable to obtain a specimen print. The process is essentially similar to Agfacolor, and will undoubtedly require the same order of control as has been found necessary for Anscocolor.

Like " Technicolor Monopack," previously mentioned, the other three integral tripacks of the chart—Anscocolor Type 735, Eastman Color Negative and Gevacolor—could all be used as the original colour record from which to obtain separation negatives, such negatives being used subsequently in conjunction with some other process for the production of release prints.

Separation Negatives

One of the most satisfactory originals from which to make separation negatives is Anscocolor Type 735. In fact it has recently been announced by Cinecolor that they will use this soft gradation material as the camera film on a feature entitled " Sunken Treasure " which they plan to make with their three-colour process.

The fact that Anscocolor materials are processed by reversal is very helpful when separation negatives are required, as there is only one copying stage involved before a set of negatives is available for use with any other printing process. Furthermore, we have found from the experiments we have so far conducted, that the specially chosen couplers used in Anscocolor Type 735 result in better colour separation than could be obtained with a set of couplers designed to provide accurate reproduction of the subject in the first place.

It seems certain that before long Eastman Color Negative, with its advantage of automatic masking, will also be used as camera material from which to obtain separation negatives.

III. TRIPACK POSITIVE

We come now to a material which can be used only with separation negatives, but which is not linked with any particular method of obtaining them. For the present at least, the new Du Pont Color Release Positive is being offered to American laboratories without a corresponding negative material.

Obviously if the subject permits it, successive frame negatives can be made, and the necessary three-strip negatives may be extracted by skip-printing. In fact, the first commercial release on the Du Pont stock was a cartoon subject called " Beyond Civilisation to Texas," and Consolidated Film Industries, who made the release prints, obtained their negatives by skip-printing from the successive frame original.

However, when live-action is involved, the negatives can be obtained in only one of two ways : either by using a three-strip camera, or from a multi-layer colour original.

Du Pont Color Positive

Du Pont Type 275 Color Release Positive has an unorthodox monopack structure, and also differs from all other commercial photographic materials in that a synthetic polymer replaces gelatine as a vehicle for the silver-halide. In fact, three different polymers are used, each one capable of forming an appropriate dye upon colour development ; in other words, the polymer molecules have colour forming structures attached to them.

It is interesting to learn from one of the several patents dealing with the new form of emulsion, that the silver-halide which forms the light-sensitive element of the layers is still precipitated in the presence of gelatine, and only after the basic emulsion has been made by normal procedure is the gelatine removed by centrifuging, and the silver-halides dispersed in solutions of the required polymer. By following this procedure, it is possible to make use of the complex speed and gradation bodies which are peculiar to gelatine ; and essential if anything more than a low speed and contrast is required.

The following description of the emulsion is taken from a Du Pont patent :—[8]

> "A protein-free photographic emulsion consisting essentially of a dispersion of light sensitive halide in a hydrophylic synthetic linear polycarbonamide, containing recurring intralinear oxygen atoms, in the ratio of one oxygen atom to each 7 to 16 carbon atoms, and recurring intralinear amide groups, which polycarbonamide is insoluble in water at 20°C., but soluble to the extent of at least 5 per cent. by weight, in water containing 40 per cent. by weight ethenol at 70°C."

The layer arrangement in Du Pont Color Release Positive departs from normal in that the magenta component image is formed in the outermost layer, the cyan image in the central layer and the yellow one in the layer next to the base. The lowermost layer is green sensitive, the central layer red sensitive, while the outer layer is non-sensitised. There is a yellow filter layer between the blue and red sensitive emulsions.

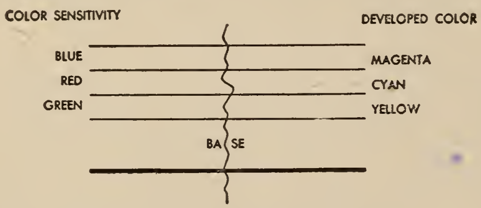

Fig. 2. Cross Section of Du Pont Color Release Positive

Printing and Processing Du Pont Stock

Printing must be carried out on a register pin step printer and the three exposures must be made through appropriate colour filters. The filters recommended by Du Pont are :—

Corning 5113 (Red)
Corning 2403 (Blue)
and Defender 60G (Green)

These are relatively sharp-cut filters, but with an efficient optical system, using a 500-watt projection type lamp, it is possible to print each record at speeds of about 20-ft. per minute.

Processing follows normal colour development procedure, and sound tracks in silver sulphide can be obtained by roller application of a sulphiding solution between the bleaching and fixing operations.

One of the principal advantages claimed for Du Pont Type 275 is improved definition resulting from the extremely thin sensitive layers, and the relegation of the least important image (from the standpoint of definition) to the bottom of the tripack where partial diffusion is inevitable.

A print on Du Pont Release Positive, now to be projected, was printed and processed by Consolidated Film Industries at Fort Lee, N.Y., from three-strip negatives made in a Dufaychrome camera. It is probable that these were the first live action subjects to be printed on the new stock.

Unified Perforation

One other point of interest about the film just projected is that it is perforated with Dubray-Howell perforations. The common type of film perforation for both positive and negative stock is being proposed for adoption, as an American standard.[9] The practice with Technicolor, Cinecolor and Dufaychrome is to use Bell & Howell type negative perforations for both camera negatives and release prints, but the projection life of film perforated with negative perforations is considerably less than that of film having the present type of positive perforation.

The problem is by no means a new one, in fact in 1932 Dubray & Howell proposed a combined positive and negative perforation having a shape similar to the existing positive perforation, but with the height of a negative perforation. Nothing was done in the matter at that time, although another attempt to establish such a standard was made in 1937. This also failed and nothing more appears to have been done in the matter until three years years ago, Arthur J. Miller, of Consolidated Film Industries, announced that the Trucolor process would use safety-base stock perforated with the Dubray-Howell perforations.

The Consolidated Laboratories use Duplex machines for their colour printing, and since they have to print from negatives bearing Bell & Howell perforations, the printing machines have been modified to work with three instead of the usual two register pins. The third pin is fully fitting in width, but reduced in height and is placed on the same side but one perforation above, the normal full-sized pin.

Cinecolor Processing

Specimens of three-colour Cinecolor were shown earlier this year, but as they had originated from 16 mm. Kodachrome it would not be fair to base an opinion on them. It may well be that the three-colour process, like two-colour Cinecolor, depends upon duplitised stock, and that this is processed to produce a cyan image on one side and a magenta image on the other—possibly by toning with iron and nickel-dimethylglyoxime respectively—and then, before fixing, one side of the stock is printed again to produce a silver image to be converted into a silver iodide mordant which is in turn used to form a yellow-dyed image.

If this procedure is followed, obviously there will be several stages at which floating, or similar unilateral treatment, is involved, and Cinecolor, by reason of the considerable experience they have had with their two-colour process, should be very well equipped to undertake such processing.[10]*

IV. BIPACK PROCESSES

Pictures are still being made in two-colour Cinecolor, and it has been announced that a corresponding process is to be operated in this country by Radiant Laboratories. We shall all await the results with interest.

An interesting innovation in the use of bipack has been introduced by Cinecolor. Previously, all two-colour photography in America has been carried out with the well-known Bell & Howell type bipack magazine ; this form of magazine works very well in the 400 ft. size, but becomes impossibly

**It has since been disclosed that the Cinecolor process depends upon the combination of an iron-toned cyan image with dye-toned magenta and yellow images, the cyan and yellow images being formed on one side and the magenta image on the opposite side of duplitised positive stock.*

large when made to accommodate 1,000 ft. rolls of stock. On the other hand, the wastage of stock due to short ends and loss of time due to frequent re-threading is a serious disadvantage of the smaller magazine. Cinecolor have met this difficulty by designing a "side-by-side" magazine and adaptor to accommodate 1,000 ft. rolls of bipack negative.[11]

Mention of Cinecolor as a two-colour process has taken me beyond reference to the chart, and I must end this report before I run the risk of confusing you, and myself, by discussing either of the stripping tripacks which are still being developed in America or the several two and "two-and-a-half colour" processes recently publicised in our own technical press.

I will conclude, therefore, by inviting you to deduce from this progress report that contrary to perennial reports of processes which will reduce colour to the simplicity of normal black and white work, processing laboratories must be prepared to accept new responsibilities and to overcome many difficulties before any colour process can be operated successfully.

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3. *J. Soc. Mot. Pic. Eng.*, June, 1948, p. 543. *Brit. Kine.*, **11**, No. 4, Nov., 1947, p. 142.
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5. *J. Soc. Mot. Pic. Eng.*, **53**, No. 1, Jan., 1949, p. 3.
6. *J. Soc. Mot. Pic. Eng.*, **38**, No. 2, Feb., 1942, p. 148. See also *J. Soc. Mot. Pic. Eng.*, **54**, No. 1, Jan., 1950, p. 35.
7. *Brit. Pat.* 599, 377.
8. *Brit. Pat.* 595,375. *J. Soc. Mot. Pic. Eng.*, **18**, No. 5, Apr., 1932, p. 503.
9. *J. Soc. Mot. Pic. Eng.*, **52**, No. 4, Apr., 1949, p. 447.
10. See also *J. Soc. Mot. Pic. Eng.*, **54**, No. 1, Jan., 1950, p. 74.
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DISCUSSION

MR. GABER: Could you tell us a little about the new Italian process?

MR. WYN GRIFFITH: Italcinecolor uses a single 35-mm. negative. In front of the film is an optical system which takes the real image formed by an ordinary objective, splits it and passes it through four colour filters—red, green, yellow and blue. The four images are reduced to the size of a 16 mm. frame and are positioned within the area of a normal 35 mm. frame. The single black-and-white strip containing the separation images can be projected by a similar optical system in full colour; it can also be printed on to coloured stock to give a print that can be projected with ordinary projectors.

The inventor stated that he had overcome the problems of parallax from which Rouxcolor suffered.

THE AUTHOR: The process is almost exactly the same as an American process known as Thomascolor. In all probability the images are not parallax free and furthermore there would be difficulty in retaining register even assuming that theatres installed suitable projection equipment.

MR. SCOTT MULLOCH: Is there any possibility of Dufaychrome coming out as 16 mm. stock?

THE AUTHOR: Dufaychrome is a process which is just as workable on 16 mm. as on 35 mm. providing you have suitable printing and processing equipment. We are building it and hope to use it for both.

MR. W. LASSALLY: Regarding Dupont release materials how do you obtain a colour reproduction if the colour of the printing light is not complementary to the corresponding separation negative?

THE AUTHOR: Each separation negative is printed through a colour filter so that the negative record corresponding to each of the positive image layers is located in the appropriate image layer.

BRITISH STANDARD

B.S. 1592-1949: *Camera Shutters*. Relates to shutters for still cameras only. Part I deals with inter-lens shutters and behind-the-lens shutters, Part II with focal-plane shutters, Part III with synchro-flash mechanism, and Part IV with cable-release sockets. Appendices describe methods of testing shutters.

AMERICAN STANDARDS

American standards have been issued for two 35 mm. sound test films, as follows:—

Z22.61-1949: *Sound focusing test film for 35 mm. Motion Picture Sound Reproducers (service type).* A 7,000 c/s variable area track is specified, recorded 1 db. below 100 per cent. modulation; variation in power level shall not exceed $\pm$ 0.25 db.

Z22.68-1949: *Buzz-track Test Film for 35 mm. Motion Picture Sound Reproducers.* On either side of a 0.288 in. opaque track are square-wave recordings, on one side 300 c/s and on the other side 1,000 c/s.

TRENDS IN STUDIO LIGHTING EQUIPMENT

Read to a joint meeting of the British Kinematograph Society and the Association of Cinema and Allied Technicians on 26th October, 1949

I. LIGHT CONTROL GEAR

L. Hewins, M.B.K.S.*

ARCS, the main source of light for colour photography, cannot be dimmed, and the only complete solution of the difficult problem of light control is, therefore, the provision of equipment which can regulate the light after it leaves the lens of the lamp.

To achieve this result shutters of the Venetian blind type, hand operated, have been in use for a number of years, but during the last year, a motor, originally developed in America, has been made available in this country which enables the shutters to be operated, singly or in gangs, from a distance. This motor, known as the "Desyn" is designed to run off the same D.C. supply as the set lighting.

Two types of controller are available, a hand controller, which will operate a maximum of 6 shutters, and a motor-driven controller which will operate 200 shutters in four gangs of 50 for lighting effects. The Desyn motor can be mounted on any shutter by means of one thumbscrew. Each motor is fitted with a reversing switch, thus enabling imperceptible changes to be made, from one light to another.

Remote Switching

This shutter system, which can quickly be fitted to almost any light on the set, fulfils the greater part of the demand for light control, but remote switching is also needed on occasions. A variety of apparatus has been developed for this, including contactor units, for two 150-amp. circuits, contactor trucks for eight 150-amp. circuits, and hand-switch trucks.

The Duarc strikes automatically, but other types do not. An automatic striker consisting of a solenoid which pulls the carbons apart against the action of a spring which can easily be fitted to an existing lamp by any maintenance shop, has now been made available.

MR. R. H. CRICKS: May we know something about the synchronous motors employed?

THE AUTHOR: They are similar in operation to A.C. Selsyns, but they are designed for operation on D.C. They are silent in operation, smooth in action, and capable of being revolved at speeds up to 300 r.p.m.

A VISITOR: Are they synchronous revolution for revolution?

THE AUTHOR: Yes, when they are connected to the same controller. The pole pieces are skewed in order to obtain the smooth action; the rotor is a permanent magnet, and the current is applied to the field coils from the controller. When the controller is turned, it energises the fields in rotation, and the armature follows the magnetic field around the poles.

MR. F. G. GUNN: When the lamp is shuttered for a comparatively long period, does it give rise to considerable temperature rise?

THE AUTHOR: It is not desirable to leave the shutter closed for too long. But for normal set working it is safe to leave the shutter closed for five minutes or so.

II. CARBON ARCS

C. G. Heys Hallett, M.A., M.B.K.S.*

TWO studio arc lamps have been selected to illustrate the trend in British design. One of them, the Type 1450 or more familiarly "The Brute," is already well-known,[1] though it has only become available within the last 12 months, but the other, "The Junior Brute," is announced to-night for the first time.

"The Brute," which at a current of 225 amps. or 50 per cent. more than the

* Mole-Richardson (England) Ltd.

Type 170 gives 2½ times as much light, goes far to meet the need for a more powerful light, while effecting an economy in current consumption.

Modernising Existing Arcs

A serious attempt was made to incorporate features in the design of "The Brute" which would improve its performance as an arc, improve the

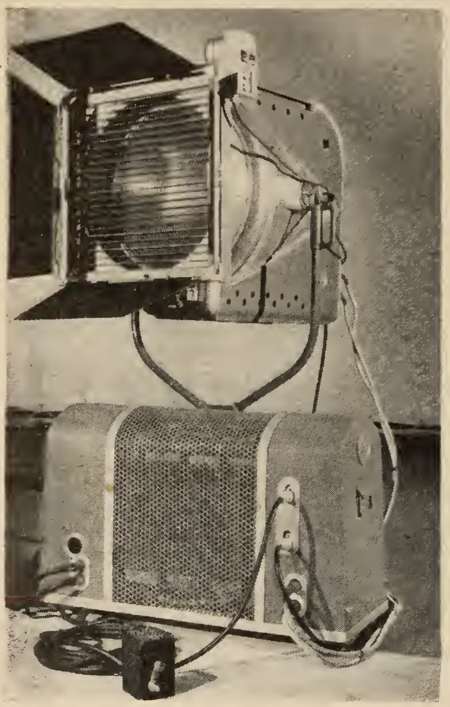

Fig. 1. Type 460 Compact source spotlight with remotely controlled shutters.

Fig. 2. Type 461 Compact source floodlight.

constancy of the light, and reduce the work entailed in handling and maintaining it. Full advantage can only be obtained from some of these new features if all the arcs in a studio are so fitted, and, in view of the capital investment involved, attention has been turned to the possibility of economical conversion of existing lamps.

The result is "The Junior Brute." Basically it remains the well-known Type 170 because the mechanism and lens are retained. The back casting of the lamphouse is changed for one similar to "The Brute" and the mechanism transferred to it. It incorporates all the features of "The Brute," the arc image and graticules, carbon warning light and polarity indicator, burning hours counter and also telescopic feed control handles, which do not project as the mechanism moves into the spot position. The increase of total weight is negligible, but the demountable mechanism results in the lamp barrel and mechanism being separable into two parts weighing 172 lbs. and 100 lbs. respectively.

Dr. Truefitt: Could the speaker tell us what the light outputs are which compare as 2½ to 1?

The Author: The relative light output of "The Brute" at 225 amps. and the 150 amp. lamps depends partly on the position of the mechanism as regards spot and flood. In the spot there is 2.1 times as much light, and in the flood the ratio is possibly 3.1.

III. MERCURY CADMIUM COMPACT SOURCE EQUIPMENT

H. K. Bourne, M.Sc., M.I.E.E., M.B.K.S.*

EARLY experiments carried out in film studios with compact source lamps, largely using converted standard equipment, have already been described in papers to this and other technical societies.[2]

The compact source mercury cadmium lamp[3] is available at present in sizes from 250 to 10,000 watts. Tests show that lamps of 5 kW. rating and above give a remarkably good colour rendering in Technicolor. So far in motion picture studios in England, mercury cadmium lamps of 2.5 and 5 kW. rating have been used, although 10 kW. lamps have also been tested experimentally.

Tests have shown that the colour rendering given by the 5 kW. lamp is superior to that given by the $2\frac{1}{2}$ kW. size.

A characteristic of compact source lamps which has retarded their application in the film studio has been the long warming up and re-striking times. Methods have now been devised by which the delays of up to 20 minutes experienced with the early lamps have been reduced to negligible proportions.

Two fittings, a studio spotlight and a floodlight, designed specifically for the new lamps, are now available.

Electric Circuits

It has been necessary to introduce apparatus, such as the high voltage impulse striking unit, of a type not previously found in studio equipment. There are three special electrical circuits in the compact source lighting unit, as follows :—

(1) A high voltage impulse unit, comprising a pulse transformer, condenser, spark gap and R.F. choke, to produce a 30 kV. surge for igniting the arc under all conditions.

(2) A low voltage impulse unit which energises momentarily the primary winding of the impulse transformer.

(3) A delay unit which closes the contactor connected across the starting resistance at a predetermined lamp voltage to control the run-up time of the lamp.

In order to simplify maintenance, these items have been constructed as three separate units capable of rapid removal and replacement. The high voltage impulse unit is enclosed in the lamphouse for reasons of safety, while the two latter units are mounted at each end of the main ballast and starting resistance in the grid. Surge suppression condensers prevent any possibility of the lamp housing becoming alive in the event of an electrical fault.

Light Characteristics

The Type 461 floodlight unit employing a 5 kW. lamp operating at 70 amps. gives approximately twice as much light as a 40 amp. Duarc, and the spread is similar. The compact source spotlight with a 10 kW. lamp gives substantially the same light output and beam spread as the Type 170 in the flood position, while with a 5 kW. lamp the output is approximately equal to that of a Type 90.

The reduction of the run-up time from 20 minutes in the early equipments to about 4 minutes, and the perfection of hot re-striking circuits, have made the provision of simmering unnecessary.

Floodlight Unit

In the floodlight illustrated in Fig. 2, light distribution equal to that from a Duarc is obtained by a rifled metal reflector combined with a front diffusing glass carried in a Type 170 lens ring. Standard diffuser equipment, barn doors, etc., may be used. The front diffusing glass in the floodlight is in strip form to reduce the chance of cracks and is protected by a wire screen.

The control grid will operate either size of lamp without any change in connections. Arrangements are made so that a 2.5 kW. lamp cannot be operated

* Mole-Richardson (England) Ltd.

accidentally at 5 kW. The grid is shaped in such a way that it can conveniently be mounted on the stand when the unit is used as a front light on the floor.

The lamphouse weighs 100 lbs. and the grid 80 lbs.

Spotlight Unit

The optical system in the spotlight (Fig. 1) consists of the standard 20-in. Fresnel lens combined with a spherical metal mirror. The size of the lamphouse has been reduced considerably and a conical shape is adopted, which increases the gangway space on the spot rail.

The spotlight resembles the floodlight in general appearance. In both units the lamp housing consists of an outer casing constructed from aluminium castings and sheet metal, and an inner removable chassis carrying the light source, optical system, high voltage impulse unit and other components.

The lamphead weighs 173 lbs. as compared with 196 lbs. for the Type 170, while the overall dimensions are the same.

A padlock on the lens ring prevents unauthorised access with consequent risk of injury to personnel by exposure to ultra-violet radiation, electric shock from the high voltage circuit, or explosion of the bulb which might be caused by sudden cold draughts. The bulb is mounted in spring-loaded holders.

A red pilot light on each side of the top of the lamphouse is extinguished when the lamp is fully run up and is ready for use. The lens ring carries a shutter, and shutter control motor, on which are mounted barn doors.

Light Control

The shutter motor may be operated in synchronism with others on the set, or may be operated from the remote control box. Focus may be controlled either by a built-in motor or by a handle on the back of the spotlight. A dial reads " Percentage Spot."

It is essential to prevent the lamp from being struck on reversed polarity. A red disc bearing the legend " Reverse Input Leads " is illuminated if the polarity is incorrect. In addition, a rectifier renders the striking circuit inoperative, so that it is impossible to ignite the arc until the leads have been reversed.

The hand controller for the spotlight is a small metal box of convenient shape for holding in the hand, or for mounting on a lampstand. It contains the following controls :—

(1) On-Off switch.

(2) " Full or Dim " switch to reduce the power in a 10 kW. lamp to 6 kW.

(3) A spot and flood control switch with a central " off " position, to control the focusing motor.

(4) A shutter motor controller.

In the case of the floodlight, the remote controller contains only a single " On and Off " switch ; no provision is made for operating the 5 kW. lamp at reduced power. This remote controller, and that used on the Type 460 Spotlight, are interchangeable.

When the lamp is switched on from cold, the pilot lights will extinguish after 3 to 4 minutes, showing that the lamp is giving its full light output. If the lamp is switched off after it has been running it may be operated again immediately without any delay. If it has been off for some time it will have cooled down so that time will be required for it to warm up again, depending on how long it has been switched off. It will cool down completely in 20 minutes and would then take 4 minutes to warm up again. If it has been off for only 5 minutes full light output will be obtained in 1 minute.

A fall in supply voltage of 1 per cent. affects the light output from the compact source lamp by approximately 3 per cent., an amount similar to that of a carbon arc, but less than that of an incandescent lamp. Reduction of supply voltage has no appreciable effect on the stability of the discharge lamp.

Again, the colour of the radiation from the discharge lamp is not affected appreciably by the variations in supply voltage normally experienced in service.

Future Scope of Compact Source Lamps

The two lamps which have been described represent a great advance on earlier models. They have a light output comparable to the average carbon arc, they are practical in design, and their silence, steadiness and freedom from smoke will lead to their use in special cases where the use of arcs is impractical, where incandescent lamps do not give sufficient light, and where cost is relatively unimportant.

The arc remains supreme as the most powerful and economical source of light, and there is little doubt that it still has a long and useful career before it, but the progress of the compact source lamp will be watched with interest.

The closest collaboration has been maintained with the Research Laboratory of the British Thomson-Houston Co. during this development work, and the author would like to acknowledge his gratitude to Mr. L. J. Davies, Director of Research of that Company, for his assistance throughout the work ; also to Mole-Richardson for permission to publish this paper.

REFERENCES

1. *Brit. Kine.*, **14**, No. 6, June, 1949, p. 183.
2. *Brit. Kine.*, **11**, No. 4, Oct., 1947, p. 107. *J. Soc. Mot. Pic. Eng.*, **50**, No. 2, p. 122.
3. " Discharge Lamps for Photography and Projection," by H. K. Bourne, Chapman & Hall. 1948.

DISCUSSION

MR. F. G. GUNN : Is it dangerous, or destructive to the bulbs, to operate them in steeply tilted positions ?

MR. BOURNE : No, these lamps will operate at least up to 45°. The chances of operating a lamphouse pointing downwards for some hundreds of hours would be remote.

MR. F. N. BUSH : What problems do you meet in designing lenses and reflectors ?

MR. BOURNE : The arc size in the compact-source lamp does not differ very much from that of the carbon arc ; the length is about 15 mm. and the width about 12 mm. But the brightness distribution is more "peaky" than that of the carbon arc, and this tends to make the beam somewhat narrower.

MR. W. NORRIS : In assessing the life of the lamps, have you a deterioration factor that you work to before the light goes off ?

MR. BOURNE : The life of any discharge lamp may end by gradual blackening, by failing to strike, or by being broken. A life of some 500 hours will take quite a long time to obtain in studio conditions.

The life of a discharge lamp is said to be finished when the initial light has dropped to 75 per cent. When the lamp blackens to this extent it often fails soon afterwards due to failure to strike.

MR. F. G. GUNN : Does ageing affect the colour of the light ?

MR. BOURNE : We have no evidence that it does to any appreciable extent.

MR. GUNN : What about de-vitrification ?

MR. BOURNE : The lamp will de-vitrify, with considerable loss of light, if it is handled with bare hands and then operated without cleaning. Preferably the bulb itself should not be handled at all—it should be held by the seals. But if it is handled it should be cleaned with a de-greaser before operating it.

MR. F. G. GUNN : As far as Technicolor are concerned, we are taking a very keen interest in the development of these lamps. They are still in the experimental stage, and so far we have not quite made up our minds as to whether they are applicable in all circumstances to our system.

MR. WAXMAN : Can you not build behind the lens a venetian shutter of translucent material incorporated permanently in the lamp for diffusion purposes ?

MR. HEYS-HALLETT : We did try something like that, but it is very inefficient.

MR. R. H. CRICKS : I saw a very interesting demonstration at the Philips factory in Eindhoven of small scale studio lighting by means of capillary lamps. Three small lamps, each running at 500 volts, 1 amp., were fed from three-phase supply and were housed in quite a small polished reflector.

DR. B. V. BOWDEN : We have analysed the records of a large number of productions, and have found that about 40 per cent. of the total time spent on the floor is devoted to lighting. Any new technical development which will in any way assist the lighting cameraman will therefore be of first-class importance in film studios.

We have found rather surprisingly that the records do not reveal any significant variation of lighting time with intensity of lighting, and that the average time required to light a set with a key-light of 80-foot candles is about the same as that required when the key light is 800 foot-candles. Possibly the time spent in manipulating small lamps is as long as that required to adjust large ones.

It would be most interesting to see how much these new remote control devices can help the cameraman.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

OBJECTIVE LENSES OF *f*/1 APERTURE AND GREATER.

E. K. Kaprelian, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 86.

Factors influencing design, together with a classification of most objectives of aperture *f*/1 or greater. An extensive bibliography is given. A. H. A.

35 mm. to 16 mm. SOUND REDUCTION PRINTER.

C. W. Clutz, F. E. Altman and J. G. Streiffert, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 669.

A continuous optical reduction printer provides a printing speed of 150 and 60 ft. per minute respectively for the 35 mm. and 16 mm. films. Photomicrographs show that the anamorphotic optical system is capable of a resolving power higher than that of fine-grain emulsion. R. H. C.

PHYSICAL MEASUREMENTS OF LOUDSPEAKER PERFORMANCE.

P. S. Veneklasen, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 641.

An outdoor installation for making free-field measurements on loudspeakers is described, including some of the special apparatus used. Typical results relating to a sample loudspeaker, and their validity as an indication of performance, are discussed. N. L.

THEATRE REPRODUCER FOR DOUBLE-WIDTH PUSH-PULL OPERATION.

G. R. Crane, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 657.

This soundhead is fitted with an optical system to accommodate both double-width and single tracks, and a combination of front and rear scanning is employed. A magnetic play-off head is also fitted and may be retracted when not in use. N. L.

HIGH-QUALITY RECORDING ELECTRONIC MIXER.

K. Singer, *J. Soc. Mot. Pic. Eng.*, June, 1949, p. 676.

This compressor-amplifier comprises a signal amplifier, having a push-pull gain control stage and a backward acting control channel utilising a full wave rectifier. A " de-esser " equaliser is fitted, and very fast acting time is claimed. Frequency response and compression characteristics are given. N. L.

SHUTTERLESS 16 mm. PROJECTOR.

Cinema d'Oggi, June, 1949, p. 133.

In a 16 mm. projector the film is fed intermittently by a system not clearly described, the shift period being so brief that a shutter may be dispensed with. R. H. C.

DEVELOPMENT AND PERFORMANCE OF TELEVISION CAMERA TUBES.

R. B. Janes, R. E. Johnson and R. S. Moore, *RCA Rev.*, June, 1949, p. 191.

A survey of the development work carried out by RCA on television camera tubes over the past 15 years. There are now three types of image orthicon available ; the 2P23 which is specially suitable for outside broadcasts where a wide range of illumination is encountered ; the 5655 which is for use in a studio where the illumination can be controlled ; and the 5769, having a sensitivity for incandescent, fluorescent and daylight lighting. T. M. C. L.

DEMONSTRATION OF LARGE-SCREEN TELEVISION AT PHILADELPHIA.

RCA Rev., June, 1949.

A description is given of a demonstration staged by Twentieth Century-Fox and RCA, at Philadelphia, of large-screen projection from a 42-in. Schmidt optical system.

The article describes in detail the layout of the equipment in the theatre, the problems which were encountered in the installation and the relaying of a programme of boxing from the Yankee Stadium in New York, over a radio link of 100 miles to the Fox Theatre in Philadelphia. The projector was mounted on the front of the balcony. T. M. C. L.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

" LENSLESS LENS " FOR TV

A new long-focus television lens, apparently based upon the Schmidt principle, has an equivalent focal length of 40 ins., an actual length of only 16 ins., and weighs only 6 lbs. The effective aperture ranges from *f*/8 to *f*/22. *Inter. Photo.*, Dec., 1949.

NEW 16 mm. SOUND TRACK

A sound track introduced in the Maurer 16 mm. recording camera contains six diminutive variable-area tracks within the normal track area. *Inter. Photo.*, Dec. 1949.

AIR-CONTROLLED ARC—NEW FILM STANDARDS

In a survey of the past year's developments, mention is made of the Ventarc, which is controlled by a current of air emanating from a tube surrounding the positive carbon ; and of proposals for new standards of sub-standard film, respectively 21 mm. and 19.58 mm. in width. *Tech. Ciné.*, Jan., 1950.

MAGNETIC RECORDING FOR SUB-STANDARD SOUND

Following a discussion on the applications of magnetic recording in the sub-standard field, details are given enabling the reader to construct a recording device.

Photo-Service, Nov.-Dec. 1949.

BOOK REVIEW

HOW TO TITLE. L. F. Minter. Focal Press. 6*s*.

This is the latest of the Focal Cinebooks and is a creditable addition to the series. Although primarily addressed to the amateur it contains much that is of value to the serious maker of narrow gauge films, particularly as the writer discusses lettering styles and lay-out with these sizes of film in mind.

He then surveys the available methods for preparing title cards, including the preparation of backgrounds and borders, and the various types of apparatus upon which they may be photographed. There are some valuable charts of camera distances and title sizes, and some practical recommendations as to methods of lining up titles, and the use of supplementary lenses, and the assessing of exposure. The latter part of the book is devoted to more elaborate effects, including animation and the use of three dimensional backgrounds.

What is commendable throughout the book is its good sense, restraint and sense of good taste. A book by a practical man.

G. H. SEWELL.

THE COUNCIL

Meeting of 1st February, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*) P. H. Bastie (*Hon. Treasurer*), B. Honri, T. Howard, R. E. Pulman, H. S. Hind, R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Mr. Bastie was welcomed by the President on his return to Society activities since his recovery from his recent illness.

Accounts.—The accounts and cash statement to 31st January were presented and approved.

New Premises.—The Hon. Treasurer and Secretary were authorised to sign the lease of the new premises under the Society's seal.

Catalogue Supplement.—A request by the Library Committee to publish an addendum to the Library Catalogue, giving books added recently, was postponed for consideration later in the year, in view of the possibility of publishing with it a list of Society members.

1951 *Exhibition.*—Mr. Cricks reported that activities in this connection had been affected by the cutting of expenditure.

Norwegian Student.—In answer to a request from the A.C.T., it was agreed to extend facilities for Mr. Jan-Erik During, a Norwegian film technician studying in this country, to attend lectures.

I.E.S.—The Vice-President and Mr. Pulman reported their intention to attend the May Convention of the Illuminating Engineering Society.

B.K.S. Convention.—The President outlined plans for the convention which would take place on 29th April, and it was agreed that the Social Committee should arrange an informal function.

Research Committee.—The giving of further consideration at the next meeting to the President's suggestion of the formation of a Research Council for the industry was approved. It should be representative of experts in the various fields and receive the support of other film industry organisations.

Friese-Greene Anniversary.—Proposals were considered for the commemoration of the Diamond Jubilee of the acceptance of W. Friese-Greene's patent.

EXECUTIVE COMMITTEE

Meeting of 1st February, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), P. H. Bastie (*Hon. Treasurer*), Miss J. Poynton (*Secretary*) and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

Robert Ian Tardrew Falkner (Associate), Dekko Cameras Ltd.
Muammer Ali Kaylan (Associate), Basic Film Unit.
F. L. Bicker (Associate), N. V. Bicker and Van der Roer, Holland.
William S. Stewart (Member), Anglo-Iranian Oil Co. Ltd., South Persia.
Eric Cyril Chipp (Member), Paramount Film Service Ltd.
Dora Evelyn Wright (Member), M.G.M. British Studios.
J. Arthur Rank (Member), J. Arthur Rank Organisation.
Douglas Hardy (Member), National Institute of Agricultural Engineering.
Robert Anthony Rigby (Member), Robert Rigby Ltd.
John Leslie Heywood (Member), Kinematograph Reuters' Society.

Transfers.—Cecil A. Hill was transferred from Associateship to Membership, and Francis David Watkins from Studentship to Associateship.

Resignations.—The resignations of three Members, five Associates and one Student were accepted with regret.

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KODAK

Kodak Limited, Motion Picture Film Dept., Kodak House, Kingsway, London, W.C.2.

COMMITTEE MEETINGS

Journal Committee—18th Jan., 1950

The January issue of British Kinematography, produced by new printers, was examined, and comments made relating to the increased legibility of the type.

After the accounts relating to the Journal during 1949 had been passed, it was agreed by the Committee that any reduction in the frequency of publication of the Journal, or any other major alteration, would have an adverse effect on the membership of the Society. Means of increasing the revenue of the Journal were suggested.

For the convenience of those who wished to collate the Technical Abstracts in the Journal it was agreed to offer single sheets free of charge on request.

Mr. Cricks mentioned the sixtieth anniversary of the acceptance of Friese-Greene's original patent which occurs in May. He was asked to prepare a brief article on it.

Library Committee—23rd Jan., 1950

Mr. Marcus Cooper, the Chairman, submitted his memorandum on "Kinematography Library Classification," the first section of which it was agreed should be circulated to all concerned. It was also intended to use the system for the classification of Technical Abstracts. Mr. Cricks submitted a draft system prepared by himself and Dr. H. Kuhn.

A trial system of allowing the provincial sections to borrow library books in bulk, which would be lent to their members under ordinary conditions, was agreed.

Theatre Division Committee—26th January, 1950

Two members of the Society were enrolled in the Division.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through British Kinematography.

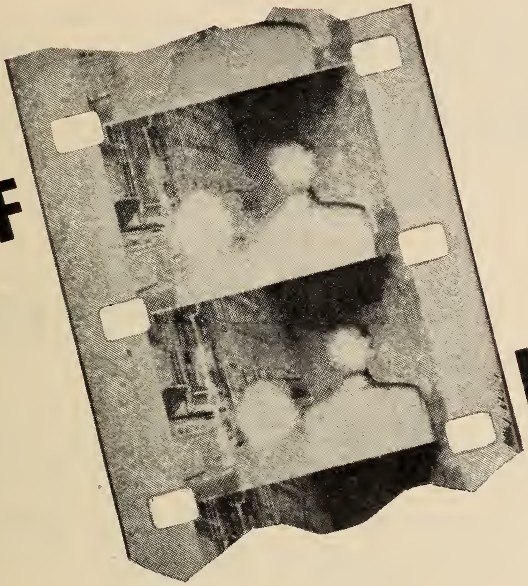
C. H. Bell has left the G.B. Kalee organisation and although he has no definite plans for the future will continue to support the Society.

Finn Bergan and Jan During are in this country on scholarships from the Norwegian Government, studying British film production methods. They are attending B.K.S. lectures.

Nigel Racine-Jacques has left Switzerland and is now with the Suomi Film Co. Ltd., in Helsinki, the largest producing organisation in the country.

Stanley Schofield has established his production centre at 11, Grape Street, W.C.2, which includes a small studio, cutting room and projection theatre.

John C. Tetard has been appointed a joint director of the Pathé (South Africa) Pty. Ltd.



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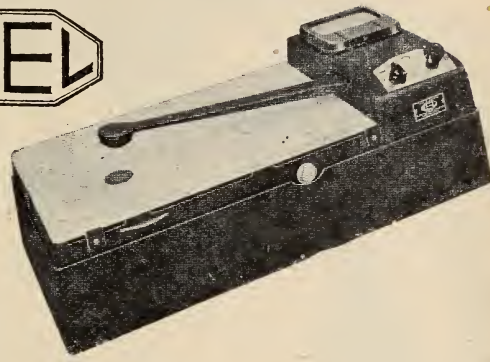

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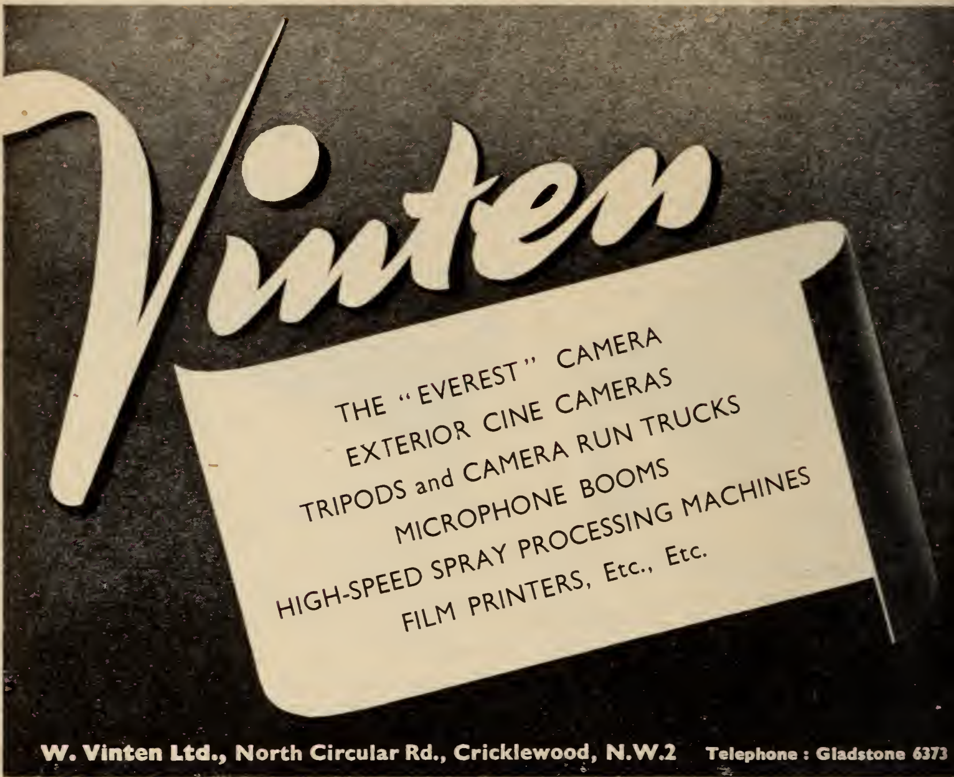
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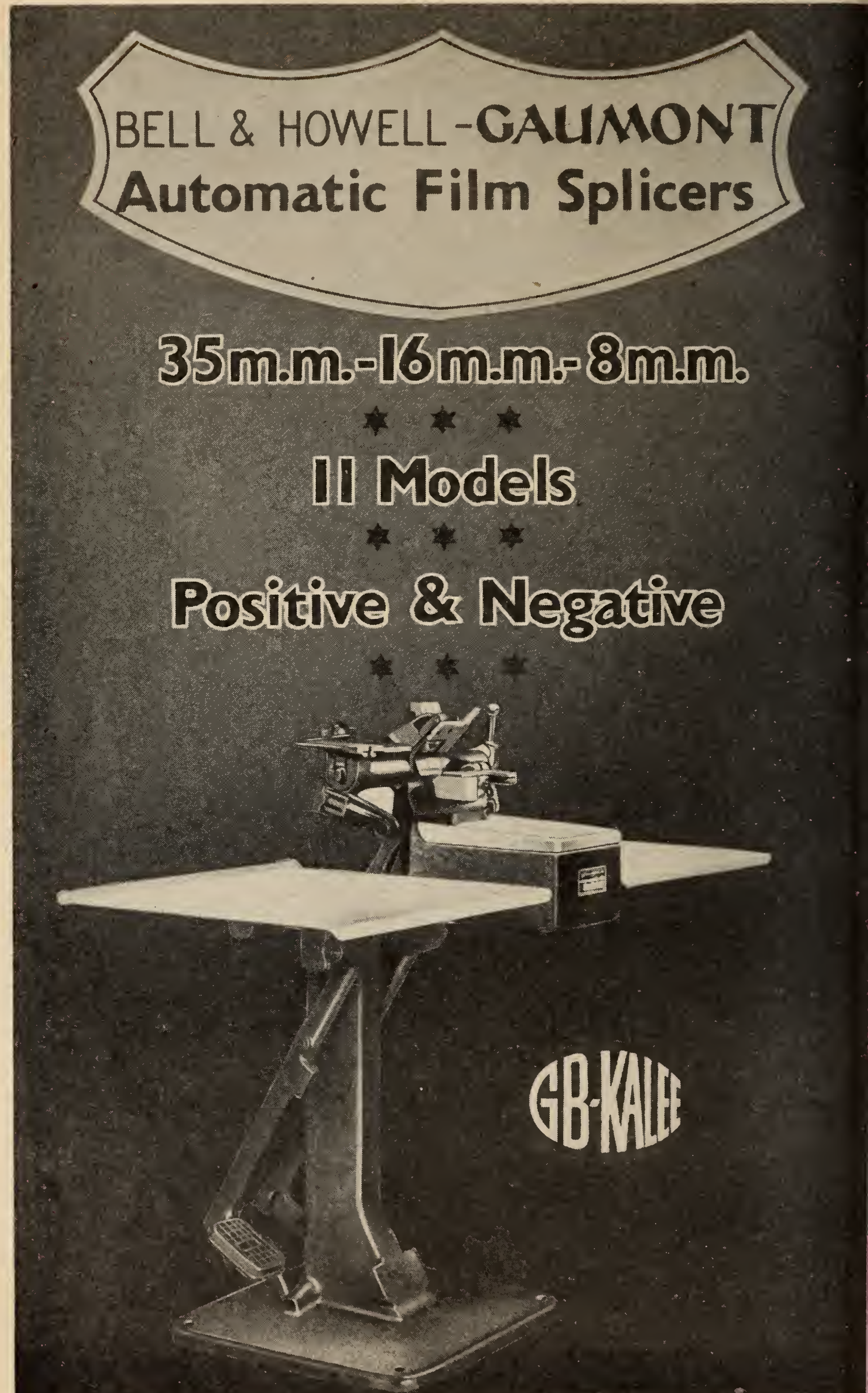
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BRITISH KINEMATOGRAPHY

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TECHNICAL REQUIREMENTS OF A MOBILE STUDIO UNIT FOR FEATURE FILMS

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Read to a joint meeting of the British Kinematograph Society and the Association of Cinema and Allied Technicians on 25th January, 1950

LAST year, two or three British feature films were produced under rather special circumstances. For various reasons to be mentioned later, it was desirable for practically the whole of these films to be shot on location, including real interiors, studio set interiors and trick shots, in addition to the exterior scenes. This necessitated the assembly of personnel and equipment on rather different lines from those usually employed on locations, and special difficulties had to be faced and overcome.

The purpose of this paper is to examine the problems encountered on three of these films, to compare them, and to advance suggestions which may possibly lighten the preparatory work of similar ventures in the future.

Why should a feature film producer wish to take " real " interior shots for his pictures instead of shooting them in the usual way in the studio? There are two reasons. Firstly, there are certain types of interiors which are difficult and expensive to build up in the studio (such as railway stations, factories, public buildings, theatres, etc.). Secondly, the exterior scenes in his film may be located in a place subject to bad weather ; in which case it may be an economic proposition to have alternative interior scenes available, inside and under cover. In the latter case, the interior scenes might be real ones, or built-up sets in a temporary studio, or both. It is the second case with which this paper is principally concerned.

Early Use of Location Studios

The idea of taking the " studio " out to the location as an alternative to bringing the " exteriors " into the studio is not a new one. The first attempts were made even without artificial lights, and at least one, the American " Imp " Company's " Ivanhoe," directed by Herbert Brenon with King Baggott playing the lead, was a big commercial success. This was produced in 1912, under the supervision of one of the founder members of the B.K.S., Capt. Paul Kimberley, and was mainly shot at Chepstow Castle. Interiors were improvised in a roofless part of the castle.

More recently, generating lorries and lights were thought to be the final answer to the problem, and Louis Mercanton produced several silent pictures in France about 1923, using a fine array of portable arc lights, generating

* Ealing Studios, Ltd.

Fig. 1. Craigstone Church Hall, Barra (foreground), converted into a temporary studio.

trucks and the like. The introduction of the first high-intensity arcs by the Sperry Company in about 1922 was thought by Sir Oswald Stoll to be the answer to the problem of lighting real interiors instead of building expensive sets in the studio.

Problems of Location Interiors

But it was not possible with the primitive and cumbersome arcs of that period to achieve results comparable with those obtainable in a fully equipped studio. Obviously, back lighting was practically impossible, and the cumulative effect of the light of the violet-coloured Westminster enclosed arcs and orthochromatic film stock of that time, gave a drab low-key result which was decidedly unpleasant.

Apart from considerations of photographic qualities, other difficulties presented themselves. Production units were liable to be evicted from the stately homes of England at the most awkward moments due to such trivial matters as heavy lorries being driven over croquet lawns, walls being knocked down or butlers being insufficiently tipped. Finally, when interiors were being shot at the Savoy Hotel for Stoll's film of H. G. Wells' "Kipps," an overloaded cable caused a snake-like burn on a very large carpet ; this resulted in a claim of over £900—after which Sir Oswald Stoll discouraged his film directors from using "real" interiors.

So far as feature films were concerned, the introduction of sound seemed more than ever to tie feature film producers to their studios, both for exteriors as well as interiors. Sound was always shot at the same time as the picture, in the sound-proofed studio. Guide tracks, post-synchronising, the dramatic use of commentary and other devices now in common use, were practically unknown. Only the documentary and commercial film ventured away from the studio.

Modern Production Trends

Feature production shows two trends, both a natural consequence of economic circumstances. First is the concentration of all actual shooting with actors to the shortest possible time, entirely in the studio. The technical achievements of "Independent Frame" have made this possible, by very detailed pre-planning, the use of "visual" sketches, a rigid adherence to the script, and the intensive use of background projection and other devices. Secondly, there is the unhesitant use of the "real thing," by taking the camera into the streets, the Underground, milk bars, shipping offices and the like. When these interior and exterior locations are far away from the studio, much time can be saved by improvising a studio for small sets, for "weather alternative" use at the actual location.

The "weather alternative" was very much in our minds at Ealing Studios when we prospected for suitable locations in the Hebrides for Compton Mackenzie's "Whisky Galore."* No doubt the same thing applied when Jill Craigie started preparation for her Welsh coal-mining subject, "Blue Scar,"

* Released in the U.S.A. under the title of "Tight Little Island."

and when Bernard Miles embarked on "The Chance of a Lifetime."

The producers of these two pictures have kindly given me a great deal of technical information. But since I was closely connected with "Whisky Galore" and am more familiar with the details, I may be forgiven for starting with this particular picture and dealing with it at greater length.

Weather Uncertainties

There was no doubt that the location of "Whisky Galore" had to be in the Hebrides. Monja Danischewsky, the Associate Producer, and Sandy Mackendrick, the Director, were quite emphatic about that, and Sir Michael Balcon approved.

Fig. 2. The Island of Barra.

The Island of Barra was to be the location—but consideration of the weather reports of many years indicated that, even in June, the number of hours of good sunshine was small, and that the deep depressions which come to us so regularly from Iceland almost invariably travel via the Outer Hebrides.

A choice had to be made : the exterior shooting, taking about eight weeks, might be followed by about eight weeks in the studio at Ealing ; this plan would call for the transport south of much "local colour"—local inhabitants and "props." Alternatively, it might be possible to schedule the whole of the shooting—interiors and exteriors — to be carried out at the location and bring back a complete film in ten weeks.

This estimate proved to be optimistic, owing to the very bad weather which

Fig. 3. An open-air set overlooking Castlebay.

Fig. 4. Hand de ment of camera

kept the unit to the studio for days on end, and extra shots had to be taken later on in the sunny south. But I insist that rumours that the *interiors* of " Whisky Galore " were shot in the Barra studio and the *exteriors* at Ealing are a gross exaggeration. The temporary studio enabled the unit to work *every day*, instead of sitting around waiting for the rain to stop.

Production Arrangements

When the idea of improvising a studio was investigated, it was encouraging to find that the islanders were most co-operative. A village hall at Craigstone, 49 ft. by 25 ft. by 11 ft. high, was the most suitable for this purpose, and Canon MacInnes, the Catholic Minister, was agreeable to place this and a second church hall at Castlebay at our disposal.

The following decisions were then made :—

(i) " Whisky Galore " would be shot entirely in Barra—interiors as well as exteriors.

(ii) The church hall at Craigstone would be converted into a studio and soundproofed, and every effort be made to obtain direct sound.

(iii) Prefabricated sections of sets, interchangeable to facilitate " revamping," would be sent up from Ealing Studios.

(iv) The headquarters of the unit would be at Castlebay, where the most lodging accommodation was available, together with the second church hall—suitable for use as a preview theatre, for synchronised rushes.

(v) Two production offices (with telephones) would be set up at Castlebay, together with prop stores, wardrobe stores, and general storage accommodation.

(vi) Local transport would be hired as much as possible, but certain special vehicles would be sent up from London.

(vii) The regular air services of B.E.A. would be used for transport of rushes or urgent journeys of personnel between London and Barra. Otherwise, personnel would travel to Oban and thence by sea. Heavy goods, prefabricated sets, equipment, props and so forth would be sent by road-rail containers loaded at Ealing Studios, and thence by rail to Oban, where they would be put on the steamer to Barra. Heavy transport would come via Kyle of Lockalsh.

Equipping the Studio

An advance unit was sent up to Barra to convert the Craigstone Village Hall into a studio. The building was of timber, with a slate roof and a wooden floor. Soundproofing and damping was carried out by draping the ceiling and walls with felt and covering the windows with slag wool, mounted on detachable wood frames. The cost of soundproofing was £85. All the felt was fireproofed, doors were made to open outwards and fire appliances were fitted. During shooting, one of the felt blankets came into contact with the top of an H.I. arc and was scorched ; had the blanket not been fireproofed, the whole place would have been ablaze.

There were few noises to be excluded, other than those of the film unit's own transport, generator and personnel. There was the distant roar of the seas breaking on the shore about 400 yards away, and the cries of the gulls, which fortunately kept near the shore. The noise of rain and wind on the roof sometimes gave trouble, but soundproofing against the terrific tempests which sometimes raged would have required very much more extensive and expensive soundproofing.

Other studio facilities were provided at adjacent buildings for timber store, a carpenters' shop, a plasterers' shop and a canteen.

Fig. 5. Interior of Temporary Studio.

Cameras and Lighting Equipment

Following a survey of the studio and the real interiors to be used on the island, the following lighting equipment was sent to Barra :—

2—150 amp. G.E.C. double-negative H.I. arcs.
1— 65 amp. Mole-Richardson H.I. arc.
2— 5 Kw. Mole-Richardson spots.
15— 2 Kw. Mole-Richardson spots.
12—500 watt M.R. spots.
2—" Bashers."
6—500 watt Photofloods—110 volts.
6—500 watt Photofloods—240 volts.
2—" Inky Dinkies."

A maximum lighting load of 500 ampères would be required, and this was provided by a Guy searchlight lorry in which the petrol engine drove a 24 Kw. generator, together with an American "Caterpillar" 4-wheel trailer, a diesel-electric unit giving an additional 30 Kw. The weight of the Guy lorry was too great for the steamer cranes to handle (maximum 3 tons) and the truck was modified so that the body-work could be readily detached and lifted separately.

Camera equipment comprised a standard Mitchell and a Newman-Sinclair for exteriors, and N. C. Mitchell for interiors, together with a G.B. velocilator. Sound equipment was a standard RCA Reo Truck (without compression), unidirectional microphones and a portable public address system. Playback —not immediate playback—was required, and a triple-spring clockwork disc machine was used, the speed being carefully checked with a stopwatch. An alternative method is to use a stroboscope disc illuminated with a neon or a 15-watt filament bulb, the lamp being connected to the 3-phase camera drive circuit. Rigging of equipment in the studio had its own special problems.

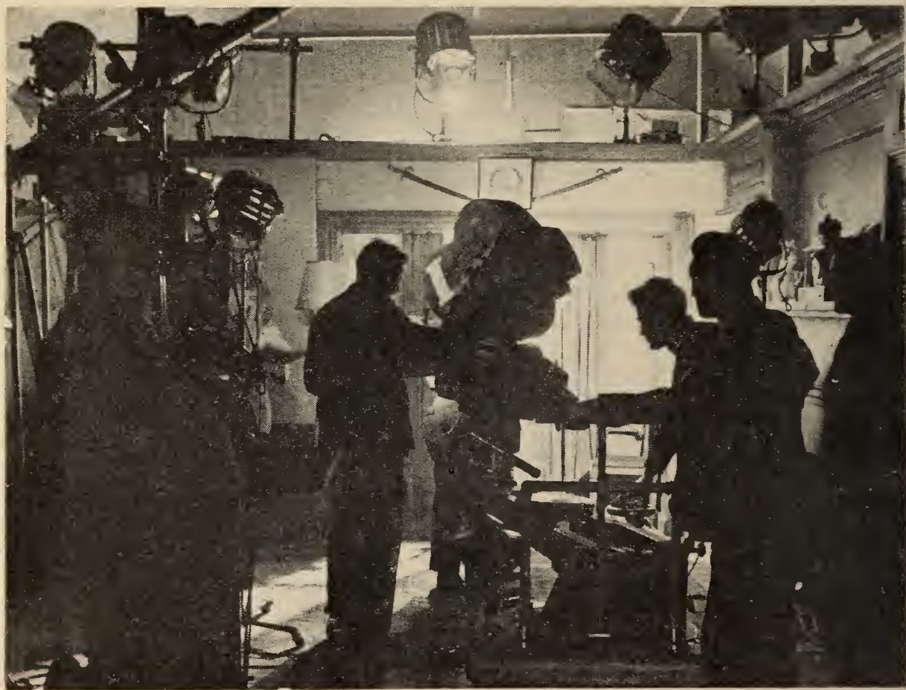


Fig. 6. A small set in the Temporary Studio.

Projection Equipment

Projection equipment included one 35 mm. Simplex machine with a clover-leaf attachment for running the separate sound and picture rushes, synchronously. This machine had a 1,500-watt tungsten lamp, and it is not surprising that a silvered screen was necessary. The amplifier was a conversion of an ex-R.A.F. general purpose amplifier.

The projection equipment included a Gebescope, used for showing 16 mm. films to the unit and islander guests. Regular 16 mm. programmes were sent up to Barra and provided the unit with evening recreation, two evenings a week, as an alternative to the alcoholic charms of the one hotel bar on the island. There was of course no kinema on the island and no electricity.

A 2.5 Kva 230 volts A.C. petrol-electric set provided current for driving the projection equipment, for the hair-dryer, paint-sprayer, charging and other purposes. It was mounted on a " jeep " trailer and was a veritable " maid of all work."

Transport Needs

At the start of the production, the following Ealing transport was assembled at Barra :—

1 Lancia camera car.
1 Prop van.
1 Open jeep.
1 Guy lorry (for transport of lamps).
1 Caterpillar generator trailer.
1 Jeep trailer, carrying the 2.5 Kva petrol-electric generator.
1 Canteen trailer.

Fig. 7. On location in the Island School.

Within a very few days of the commencement of shooting, this was found to be inadequate, and the island transport was found not wholly reliable. Additional transport was sent up as follows :—

1 Vauxhall car.
1 Utility van jeep.
1 Motor cycle.
1 Additional jeep trailer.

On production work of this kind, the importance of transport cannot be exaggerated. The weather was almost unpredictable, and alternative studio and exterior calls were the rule rather than the exception. With a gloomy sky, a day's work might start in the studio, or at a " real interior " such as the bar or the school. But within two or three hours there might be one of those rare breaks of sunshine, and the unit must be ready to abandon an interior at the first convenient moment and dash out to the location. Good transport will enable this to be done, and if lights are required on exteriors, sufficient supplementary cables and lamps should be taken to permit change over from interiors to exteriors with the minimum of delay.

The value of the jeep as a location vehicle cannot be over-stressed. It can be used for so many purposes—it can negotiate the roughest ground and sand, it is useful for trailing other vehicles and for hauling them out of ditches. Jeep couplings were fitted to all vehicles. The mobile canteen, trailed by a jeep, was a big success.

Processing Arrangements

During the production of the film, each day's takes were sent on the 4.15 p.m. plane from Barra to Glasgow, where they caught the 6.30 p.m.

	"WHISKY GALORE"	"BLUE SCAR"	"CHANCE OF A LIFETIME"
NORMAL USE	CHURCH HALL	CINEMA (700 SEATS)	DISUSED FACTORY
STAGE DIMENSIONS	49' × 25' × 11'	60' × 40'	40' × 25'
SOUND PROOFING	FELT & SLAG WOOL BLANKETS	CANVAS TENT DRAPED FROM WALLS & ROOF	FELT BLANKETS
SOUND SYSTEM	R·C·A	WESTERN ELECTRIC	R·C·A
POWER SUPPLY	24 KW (GUY LORRY) 30 K·W· (TRAILER) (500 AMPS TOTAL)	LOCAL MAINS A·C PLUS GENERATOR (800 AMPS OUTPUT)	LOCAL MAINS A·C PLUS GENERATOR (500 AMPS OUTPUT)
LIGHTS — ARCS:	2 G·E·C 150 AMP H·I 1 M·R· 65 " "	1 M·R· 65 AMP H·I	2 M·R· 150 AMP H·I
LIGHTS — INKIES: (M·R·)	2 5 K·W· 15 2 K·W· 12 500 WATT 'PUPS' 2 BASHERS 12 PHOTOFLOODS	1 5 K·W· 10 2 K·W· 6 500 WATT 'PUPS' 2 BASHERS	17 2 K·W· 12 500 WATT 'PUPS' 6 500W· BASHERS

Fig. 8. Comparative facilities in three productions.

plane for London. The laboratory collected them and was able to develop and print them the same night. A report on the rushes was telephoned from the studio on the following morning and they were immediately flown back to Barra. There, the unit were able to see the rushes in the Castlebay Church Hall, on the double-headed projector, only two days after shooting.

The camera department improvised local developing facilities for checking purposes, sufficient to accommodate lengths of film long enough for projection as loops when necessary. This was valuable when the intermittent motion of one of the cameras became unsteady. Following adjustments, the usual steadiness tests were shot, developed on the spot, and projected for examination.

Apart from real and improvised interiors, glass shots and foreground models were used, especially on shots of the wreck of the vessel. A section of the wreck, built on the Western Shore, was actually " wrecked " by the storms before it could be shot !

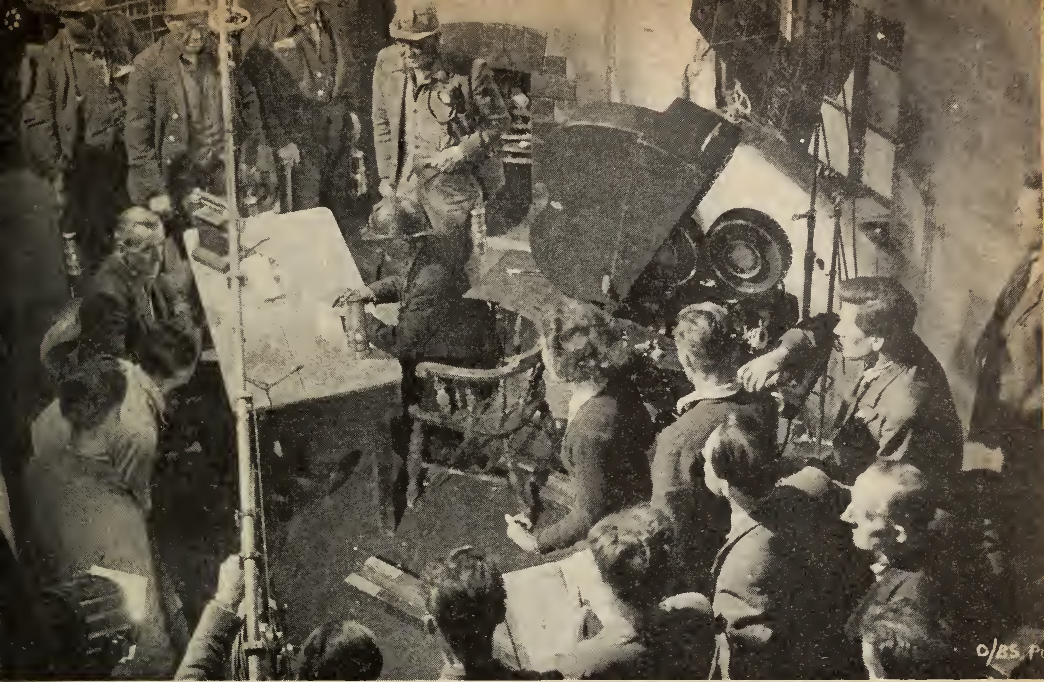


Fig. 9. Jill Craigie directing a shot from " Blue Scar " in the Temporary Studio.

Filming in a Kinema

At almost the same time as " Whisky Galore " was being shot, " Blue Scar " was being made at Port Talbot, Wales, by Jill Craigie and William Macquitty.

In this case a disused kinema was converted into a studio with a floor space 40 ft. by 60 ft.—somewhat larger than the Barra stage. The kinema floor had a rake, and a new one had to be put in. This floor extended from just under the circle up to 10 ft. or so from the screen. Sound absorption materials were draped from ceiling and walls, and a make-up room, dressing rooms and a dark room, and other accommodation was improvised on the premises. Preparation of this studio occupied three weeks. (Fig. 9).

The chart of Fig. 8 makes a comparison of the main studio technical facilities available at Port Talbot compared with those at Barra, and also those at Stroud, where Bernard Miles had his temporary studio for " Chance of a Lifetime."

Sound and Camera Problems

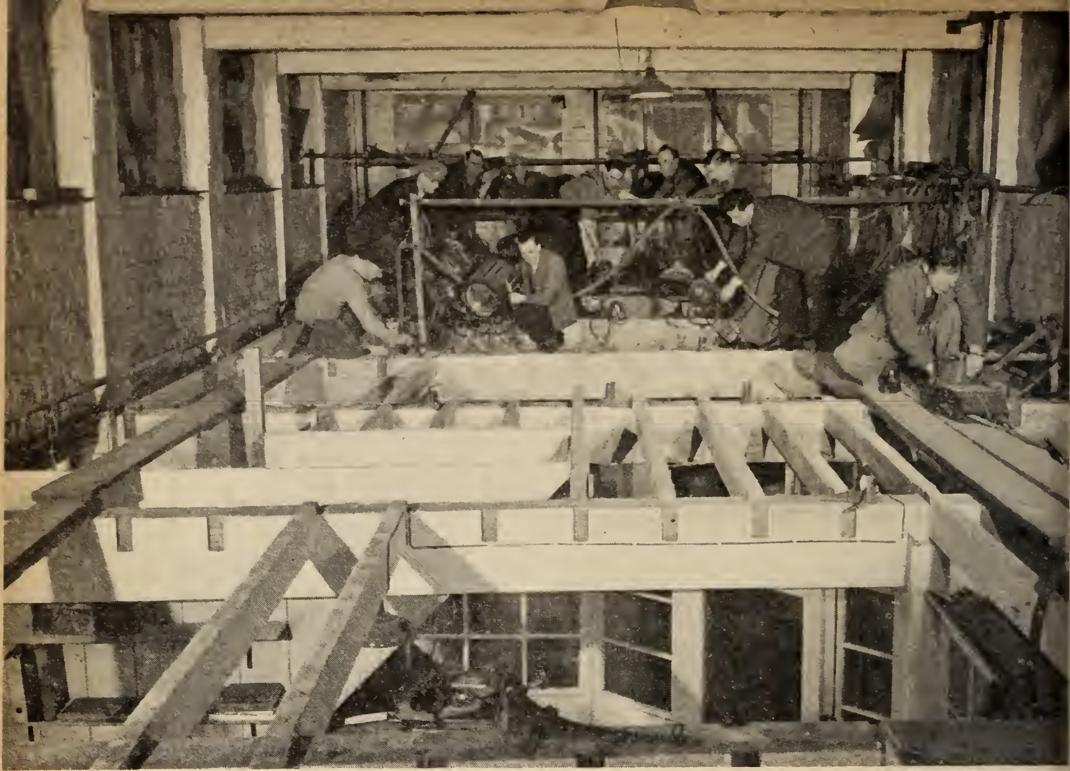
The studio at Port Talbot was situated in a fairly populous neighbourhood, and difficulties arose over the noise of the outside portable generator. But fortunately, the town mains supply in the kinema provided sufficient alternating current for the tungsten lamps. Outside noises from train whistles and heavy rain interrupted shooting, but otherwise the temporary stage was quite successful.

Towards the end of shooting, the new floor began to warp and camera movement was practically impossible, especially at the screen end of the new floor, where it was built up. Rushes were viewed in a nearby kinema—unsynchronised—and this was a handicap for Producer and Director, notwithstanding which they turned out a remarkably smooth technical job under difficult circumstances.

Studio and real mine shots were intercut. The real mine shots were photographed with three 2 Kw. mine floodlights hermetically sealed (film studio lamps could not be used for obvious reasons).

Adapting a Disused Mill

For " Chance of a Lifetime," which Bernard Miles produced for Pilgrim



Courtesy of Pilgrim Pic

Fig. 10. Floorboards removed above Temporary Studio at Stroud to form lighting " grid " for " Chance of a Lifetime."

Pictures, a completely different set of circumstances presented themselves. Here was a story largely set in a factory, with interiors and exteriors. It was discovered that adjoining the modern wool weaving mills of Messrs. Marling and Evans, at Ryeford, Stroud, Gloucestershire, was an old factory, disused for many years and empty. A temporary studio and the usual technical workshops and dressing rooms were set up in this old mill, and a studio was improvised by removing floorboards between two floors and using the beams and supports as a lighting grid.

Many rooms in this, and, I believe, in the main factory were used for shooting, and one of the principal difficulties was found to be the varying light intensity of the daylight coming through the windows, especially when these were actually " in picture." Very many of the camera set-ups included these windows and their view outside, and unless particular care was taken, by fitting the appropriate coloured gelatine filter over the glass panes, the weather outside might vary from bright sun to deep gloomy storm clouds in the same sequence.

The unit devised all kinds of supports for small lamps, when shooting in confined spaces, and an example is shown in Fig. 10.

The rushes were shown at a local kinema, synchronised. Married prints were used.

Value of Mobile Studio Unit

What lessons are to be learned from these ventures? What is the specification of desirable equipment enabling first-class work to be produced by a Mobile Studio Unit?

My definition of a Mobile Studio Unit is that it is a collection of equipment —not too bulky or heavy—which can be moved to suitable existing premises, enabling them to be converted rapidly into a film studio. If the location schedule calls for 20 or more full shooting days in a given locality, it will be worthwhile providing these local facilities.

Requirements of Location Studio

Naturally, the premises should be situated away from main road traffic, airfields or other noisy places. The main hall or room should have a floor area of approximately 2,000 sq. ft. and a height of 14 or 15 ft. A brick building is desirable, but usually this requires much heavier sound damping than a wooden one. Slag-wool blankets are an excellent dual purpose material, reducing both internal reverberation and outside noise at the same time. If carefully handled the material is recoverable ; it is fireproof, but it is fairly expensive. Therefore, other blanketing materials, such as felt, may be used on those walls and ceilings which are already fairly soundproof. The felt should be reasonably thick, and it *must* be fireproof.

Doors should be made to open outwards and one or two extract fans should be fitted, covered with flap-doors. Signal lights must be fitted.

Provision should be made on the premises for three or four dressing rooms, if possible, together with a dark-room, production and drawing office, prop stores, wardrobe stores, set stores, carpenters' shop and a combined plaster and paint shop.

Offices and Billeting

The main production office, with telephone, should preferably be situated in the centre of the lodging accommodation—which may not necessarily be close to the temporary studio. The Unit Production Manager's office tends to become a common room if it is easily accessible to callers, and concentration or privacy are quite impossible. The ideal layout comprises two rooms on the ground floor of a private house, one leading to the other ; the front room should have a temporary portico outside the window, so that enquiries can be dealt with, crowd artistes paid off, post and call sheets handed out, etc., without the callers having to enter the building.

One of the greatest difficulties about M.S.U. organisation is the matter of billeting. In the kind of places where this system of production seems to be desirable, there are usually no hotels—or, maybe, one large hotel with prohibitive prices and insufficient accommodation for the whole unit. The choice lies therefore between boarding the Unit out at cottages or improvising some kind of temporary camp or hostel, run by the production company itself. This is a method which Mr. Bernard Miles is contemplating for his next picture, although I am not altogether in favour of it.

If the exterior locations are situated in various outlying villages or hills, an efficient transport service is absolutely essential—especially if it is desired to change over from studio shooting to exteriors at short notice. The list previously given can form the basis of transport requirements.

Technical Requirements

Power for studio lighting, night exteriors or for boosting daylight shots is a most important factor ; from 50 to 80 Kw. of electricity should be available. Two small trucks are obviously better than one large one for this purpose. Most of the small sets can be handled with 30 Kw., and the cameraman can make his own choice of lamps, bearing this in mind. Ample pre-preparation and reconnaissance by key technicians is essential.

There is no need for me to specify particular camera equipment, although a properly blimped studio camera and velocilator are essentials. But adequate provision for local development, enlarging and other testing as already mentioned is most important.

If there is a large proportion of exteriors in situations away from the main roads, then the usual large sound truck is too clumsy. This can be left at the temporary studio and a light portable equipment on a jeep trailer can be used. A good disc recorder or a magnetic recorder will suit admirably. If playback is required in such locations, then a portable spring gramophone will serve, providing stroboscopic control of turntable is used. Other accessories should include portable public-address equipment and a number of field telephones.

Power supply for driving the sound and picture cameras is usually provided by a motor alternator in the sound truck, running off banks of accumulators and giving 220 volts 3-phase 50 c/s. output. An alternative source of 3-phase supply becomes available by using a small 3-phase petrol electric set, or by using a Westinghouse artificial 3-phase converter in conjunction with a single-phase petrol-electric set. This may be mounted on a jeep trailer.

Projection

I am more than ever convinced that the policy of seeing rushes at a local kinema, unsynchronised, usually in the middle of the night, is a bad one from every point of view. A portable sound projector capable of running studio rushes, with the normal separate sound and picture reels, at any time, is well worth while.

The necessity of having to erect a projection box enclosure or the making of projection ports through walls must however be faced, together with the need for the usual fire precautions.

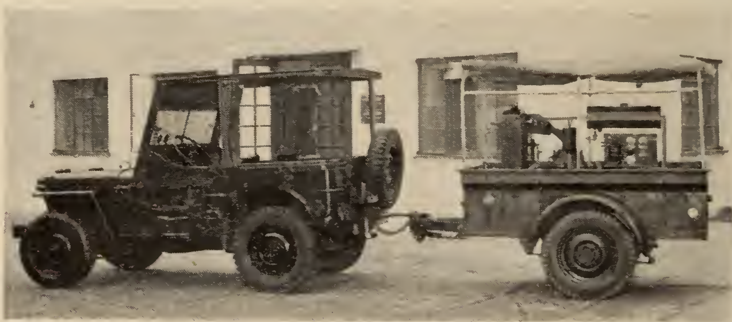


Fig. 11. The " Maid of all Work," a 2.5 Kva petrol-electric generator on a Jeep trailer, towed by a Jeep.

Stage Equipment and Tools

These should include a paint sprayer, which if electric can be driven by the small portable petrol-electric A.C. set. However, it is probably better to use a separate independent petrol-engine driven compressor, as it will be found that the " maid of all work " is fairly fully occupied.

Stage equipment should include light tubular scaffolding, and rostrums. Stock flats, doors and other scenic effects will have been sent up from the main studio.

There should be an adequate supply of sound "goboes"—felt stretched on frames—for use particularly when real interiors are being shot. Too much stress cannot be laid upon the importance of blanketing all parts of a hall or room which are not in picture.

Sad experiences with paraffin pressure stoves induced us to try Calor gas rings for our mobile canteen with complete success. We now have at Ealing two trailer mobile canteens, both fitted with Calor gas, and the larger one has a normal gas cooker. Naturally, Thermos containers for hot food and drink and properly sealed water containers (*e.g.*, milk churns) are essential.

Battery charging is an important item. With a rectifier, the " maid of all work " petrol-electric set can be used. However, it is preferable to arrange local facilities for night charging at a garage or telephone exchange, if possible.

Welfare of Personnel

Lastly, welfare equipment such as games, radio sets, a 16 mm. projector, and a first-aid post, are things which should not be forgotten, especially if there are no local recreational facilities.

Some of the items I have mentioned do not come strictly within the category of technical requirements of a mobile Studio, but their omission would have been a grave error. A large part of the Unit Manager's time is spent dealing with landladies, food, baths and sanitation, and so forth.

I believe that there is a future for Mobile Studio Unit working on specialised subjects which have a high percentage of exteriors. Too often have large location units sat about gloomy hotel lounges looking out of the window at gloomier skies. We all know how weeks have passed by on Scottish locations without a glimmer of sun. The Industry can no longer afford this sort of thing. The Mobile Studio Unit system avoids this waste and gives the producer an opportunity of getting something " in the can " every day.

DISCUSSION

Mr. Marcus Cooper : Have you considered the advantages and disadvantages of cutting a film on location ?

The Author : The strict fire regulations for cutting rooms and film storage make that practically impossible.

Mr. N. Leevers : A trailer could be fitted up as a complete cutting room.

A Visitor : It will help documentary people to know how you get sound on location. Is it better to damp down, or shoot anywhere and post-sync afterwards ?

The Author : It is desirable to get direct sound if you can. For small real interiors, portable sound goboes will do the trick, unless the interior is large and bare. On exterior location, there is less likelihood of getting direct sound, owing to the variation of background noise of vehicles, spectators and so forth. Spectators are especially attracted by lights at night, but fine results can often be obtained by the substitution of photofloods in existing street lamps instead of using obtrusive studio lamps on stands. Many examples of this type of work can be seen in " The Blue Lamp." The co-operation of the lab. in providing special processing for this kind of shot is essential.

Mr. T. S. Lyndon-Haynes : During the shooting of " The Third Man " in Vienna, the tendency was for us to shoot a good many guide tracks owing mainly to the prevailing conditions. However, unless there are good reasons to the contrary, actual usable tracks should be sought. The time of artistes engaged for post-synchronizing later in the dubbing theatre will add to the cost of production.

Mr. W. J. Moylan : Much stress has been laid on sound-proofing and blanketing, and post-synchronising has been dealt with as if undesirable. Post-synchronisation on at least one British process is not only desirable but technically and artistically perfect.

Mr. W. S. Bland : DC-AC interlock drive has advantages compared with using a three-phase generator.

The Author : Most British studios have standardised upon 3-phase motors. The AC-DC system is more suitable for exterior use, but I would not favour mixing the two systems.

Mr. Langley : Have you considered taking a mobile processing unit on location ?

The Author : No. If you can get the rushes back from the lab. in two or three days, that should suffice.

Mr. Gunn : What about using a small camera crane ?

The Author : A standard type of Fearless or Vinten velocilator should be provided for the studio and an Austin dolly for exterior shots.

Mr. Harry Waxman : I was interested to see the limited range of lighting equipment you took with you. I would have chosen a lot of smaller lighting units, inky-dinkies, and very big ones, like Duarcs, which are very useful especially for interior-exteriors.

Mr. Macquitty : Did you have a camera maintenance technician ?

The Author : We flew one up to Barra when camera trouble developed.

Mr. Gunn : At Technicolor we send a camera maintenance mechanic on distant locations.

A Visitor : Laying tracks over rough ground can be disastrous with local labour.

Mr. B. Langley : The simple way is to lay an H-channel which can go all over anything.

Mr. Waxman : What tracks do Ealing use in the studio ?

The Author: H-channel duralumin tracks, which are very light and strong.

MODERN KINEMA EQUIPMENT

III. ACCESSORY EQUIPMENT AND FILM MUTILATION

R. Anthony Rigby, M.B.K.S. *

Read to the B.K.S. Theatre Division on 11th December, 1949

FOR many years the view was widely held that accessory equipment, far from being a necessity in a projection suite, was merely a luxury—or even, alas, an extravagance. Nowadays, however, it is generally realised that modern accessory apparatus is of paramount importance in attaining the highest standards of projection and showmanship which should be the aim of every projectionist and exhibitor.

Before enumerating and illustrating various items of vital accessory equipment, let us consider in some detail methods of prevention of film mutilation, to which end, of course, projection ancillary equipment has primarily been designed.

Characteristics of Film Stock

Motion picture film consists of three components, the *base*, the *substratum* and the *emulsion*. When during the manufacturing process the raw cotton is treated with a nitrate compound then cellulose nitrate base is produced ; if the other main constituent with the cotton is an acetate compound then cellulose acetate base is produced. The modern 35 mm. non-inflammable base is a cellulose tri-acetate, and the splicing of this base is considerably more difficult than that of nitrate.

It can be readily appreciated that we are dealing with a substance of the utmost fragility that demands the most delicate handling at all times ; we must never allow " familiarity to breed contempt." While fully cognisant of the conscientiousness of the majority of projectionists in the handling of film, nevertheless film mutilation is so prevalent and avoidable that this aspect must be laboured in detail.

One sees sprocket hole marks running down the centre of film for hundreds of feet ; scratch marks of equal dimensions ; broken sprocket holes ; private change-over cues of grotesque designs and sizes, and faulty splices.

Causes of Mutilation

What are the causes of this wanton wastage ? First and foremost it is carelessness ; R. Howard Cricks has written so correctly in *The Complete Projectionist :* " The largest proportion of film mutilation is due either to sheer carelessness or sheer laziness, neither of which can be tolerated in the projection room." Other general causes are inadequate cleanliness—dirt is the greatest evil not only in our industry, but in any which handles delicate material ; lack of maintenance ; incorrect handling of " green stock "—though in fact no print should reach the kinema without previous wax processing ; distorted spool flanges, misaligned or worn spindles and bearings in projectors or rewinders and, of course, faulty splicing.

As much damage can be occasioned during rewinding and splicing as during projection. There would appear to be little excuse now for the continuance of private change-over cues in view of the British Standard No. 1492 of 1942 regarding 35 mm. release prints, with which all renters are now complying. This standard calls for a protective leader, an identifying leader and a synchronising leader.

It has been observed that some kinemas receive copies without these leaders, but as all copies leave the renters complete it must be presumed that these

* Robert Rigby Ltd.

leaders are "mislaid" or removed, thus causing other projectionists to insert their own cues. However, even here there is a great difference between neatly inserted cues in the top right hand corner of the frame, and the grotesque hieroglyphics mentioned earlier.

Rewinding Faults

In rewinding and splicing the importance of the human element exceeds the mechanical (though we do not wish to convey that projection mutilation through mechanical defect exonerates us, for surely we are masters of our own creations). Much mutilation can be caused in the rewind room through faulty equipment ; efficient accessory equipment is indispensable, and with such equipment mutilation can be entirely eliminated.

Some common rewinding faults are these : the main and auxiliary ends of many rewinders are out of alignment ; others have worn spindle bearings causing an elliptical and not a circular movement ; others have inadequate braking tension on the idle end ; some indeed combine all these defects, and one need not pursue further the imminent danger to film with such apparatus. And again the human element : rewinding too fast—failure to examine film

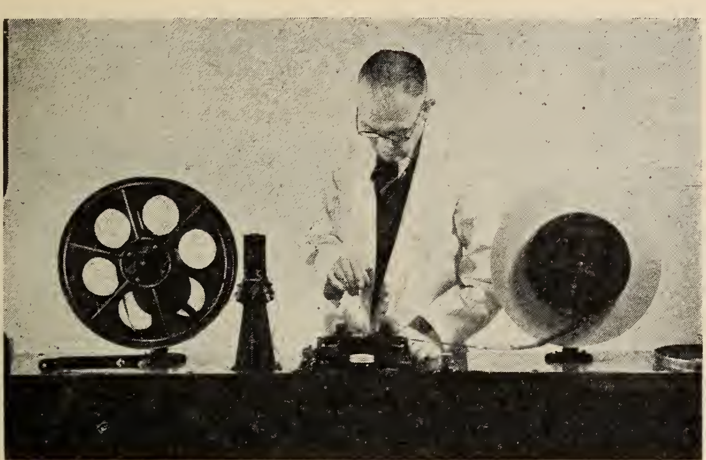


Fig. 1. "Premier" All-metal Rewind Bench

—emulsion side downwards when it should be upwards—inadequate or even non-existent spooling-on and spooling-off discs : all these factors, so easily obviated by available equipment, cause untold damage.

Need for Joining Press

And splicing : how many realise how important this aspect is ? "The joining or splicing of film has a very material bearing on its life and is a matter that calls for special attention" ; so wrote Denis Wratten of Messrs. Kodak Ltd. ; yet so often one hears, "I can make a better join by hand than with any splicing machine." This is not correct, for how can anyone ensure perfect sprocket-hole overlap, perfect alignment of the sides of the film, abrupt pressure to expel the air bubbles, or, in fact, even an adequate pressure over the whole width of splice by hand ? It may be possible to make an adequate join by hand, but not a perfect one, thus I suggest much mutilation is caused by hand splicing—bad overlap, bad alignment, excessive width or stiffness ; all or any of these defects will cause breaking and tearing of the film. A mechanical press is, in any case, essential with cellulose tri-acetate stock.

There is this consideration which should be mentioned regarding splicing in general : it is imperative to use a reliable cement and to refrain from applying it in excess.

Modern Rewinding Equipment

The rewind bench illustrated in Fig. 1 contains all the necessities for an efficiently equipped rewind room : rewinder, film keep (which is illustrated separately in Fig. 2), de luxe film joiner (for nitrate and tri-acetate film stock), film waxer (for green prints), scrap film bin, drawer for tools and spares, 12-way interlocking spool cabinet, two open 6-way spool cabinets. This complete unit can be accommodated in a space of 6 feet by 2 feet.

In the illustration the projectionist can be seen making a join during the spooling up of his programme from the 2 in. renter's core, used in conjunction with the " Premier " stripping plate, on to his 15 in. spool, which must conform in all respects with British Standard Specification No. 1587 of 1949, regarding Cinematograph Spools. When spooling-off, the projectionist merely reverses the operation by placing his projection spool on the idle end and rewinding

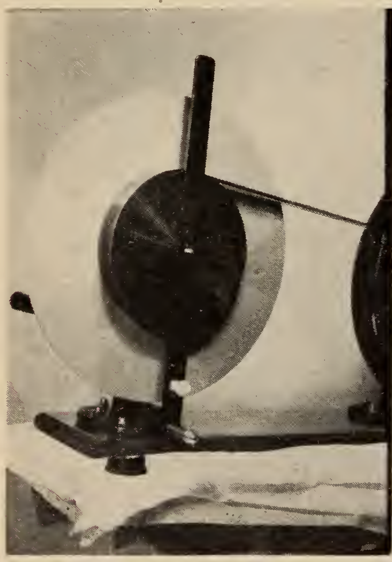


Fig. 2. Film Keep

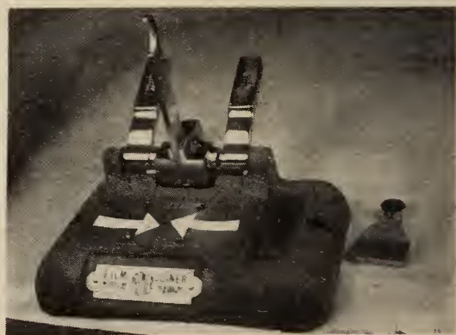


Fig. 3. " Premier " Standard Joining Press

on to the 2 in. renters' core, which is used in conjunction with the plate and " film keep " as in Fig. 2. This film keep ensures absolute evenness of the roll ; it is spring-loaded at its base and lies flat on the bench when not in use.

Rewinding technique can be much facilitated by standardisation of equipment, both by exhibitors in their theatres and by renters in the dispatch of copies. The difficulties are great, but the eventual results would justify any initial cost and reorganisation. I have been told that in those areas of the United States where the procedure of film dispatch has been standardised, the financial losses through rewinding or transit mutilation have been reduced by as much as 75 per cent.

Use of Splicer

And so finally to splicing. Apart from precision in overlap and alignment, what constitutes a good join ? A good join is actually a weld, when one side of the film base is partly dissolved into the other section to be joined. This means that to ensure a perfect join it is necessary to remove by scraping not only the emulsion, but also the substratum, so that there is base in contact with base. It must be conceded that with nitrate stock it is possible to make an adequate join without removing the substratum, but with tri-acetate this is not so, and it is absolutely imperative to remove the substratum layer completely.

This is not possible without some kind of mechanical scraping device. In Fig. 3 is illustrated a joiner specially designed for this new stock, in which are embodied all essential requirements : the file type scraper to remove emulsion and substratum, a guided rotary cutter to effect correct trimming, precision pins to ensure perfect overlap and alignment, and a spring-loaded centre bar that not only applies adequate tension during the welding operation, but also—and this important requisite is omitted from a number of joiners—it expels the air bubbles from between the two pieces of film by its *initially abrupt impact.*

Punctilious care in the handling and treatment of film is not only in the interests of our industry, but it has without doubt a national implication. Film stock costs dollars and if we waste it we waste dollars, if we conserve it we conserve dollars.

I conclude, therefore, by asking you to consider that it might well be factual that much mutilation is indeed caused by obsolete methods and equipment, and conversely that great economies would be effected by the correct utilisation of the latest kinematograph accessory equipment.

DISCUSSION

Mr. P. W. Clark : Would it be possible to make a template, to be issued to every theatre, so that the projectionist could put on his cue dots ?

Mr. R. H. Cricks : Many years ago I designed such a template, which was to have been supplied free of charge to kinemas. The K.R.S. objected to it, on the grounds that it might lead to film mutilation.

A Visitor : On spooling up a film on tri-acetate, every join came adrift. Has a projectionist's hand-made join stood the test against machine-made joins ?

The Author : I do not know how you are going to get the sub-stratum off the base without clamping it and using some sort of file or similar implement ; I do not know how you are going to get the initial impulse to expel the air, and finally how you are going to apply even and considerable pressure for twenty seconds.

Mr. W. V. DeWan : With regard to waxing, in the summer the wax piles up because of the high temperature.

The Author : I have asked for wax with a higher melting point than had hitherto been used. Whether that has been satisfactory in actual use I cannot say.

Mr. A. E. Ellis : One of the finest moves towards the reduction of mutilation would be the installation of equipment such as we have seen, as standard in every theatre. A standard splicing machine would show a great reduction in the mutilation caused by bad splicing. As regards tri-acetate base, to make joins successfully a splicing machine must be installed in every rewind room.

On the subject of green prints, as a representative of a renting firm, I do not recognise the term, because every film we send out is waxed, with the exception of the newsreels.

If a projectionist, on receiving a print, finds scratches or damaged perforations, he should let the renter know before the first run. After having run the film two or three times, the projectionist is likely to get the blame for that damage attached to him.

On the subject of the bakelite core, if films go out on those cores they will arrive with the core smashed to pieces. If we were to put one of these cores into a 1,000 ft. reel of film and drop it from a height of 3 ft. on to the ground, the core will be broken.

The Author : The size of the core has been found satisfactory ; what has been found wanting is the material used. You could use a die-cast metal.

LECTURE PROGRAMME, 1950/1.

The Papers Committee now has under consideration the programme of lectures for the session 1950/51. It is anxious to arrange lectures upon such subjects as will be of greatest use and interest to members. In this respect, the Committee seeks the help and advice of members and therefore invites their suggestions and views.

The Committee will also welcome offers of papers on any subject related to kinematography, and every facility will be afforded to members in arranging for the delivery and publication of papers. Suggestions and offers should be forwarded to the Secretary and should arrive, if possible, not later than 24th April next.

L. Knopp,
Acting Chairman, Papers Committee.

IMPROVEMENTS IN LARGE-SCREEN TELEVISION

T. M. C. Lance, M.B.K.S., F. Tele. S.*

Summary of address to the B.K.S. Theatre Division on 12th February, 1950

MENTIONING that he proposed presenting a summary of the paper which he had read on 13th September, 1949, to the International Television Congress at Milan,[1] Mr. Lance referred to the tragic death of Capt. A. G. D. West, who was to have read this paper to the Theatre Division. At this Congress, the equipment had been demonstrated to no fewer than 70,000 persons.

Before turning to his paper, Mr. Lance recalled earlier attempts at large-screen television. In 1925, John Logie Baird had presented at the London Coliseum a system which comprised a screen of 2,100 lamps, controlled by means of a commutator system ; the definition was only of 30 lines. A similar system had been employed by Karolus, in Germany, using 100 rows each of 100 miniature cathode-ray tubes ; an intensity of 200 foot candles had been produced on a screen measuring 5 ft. by 4 ft.[2] Baird had also demonstrated other systems of a more conventional nature.[3]

Before Cinema-Television had embarked upon large-screen projection, an investigation had been undertaken to ascertain the number of lines needed to produce an image equal to that of the film. It was probable that the optimum number of lines was 800 ; the standard employed in the existing Cintel equipment was either 405 or 625 lines.[4]

In the course of his paper, Mr. Lance referred to the improvements in camera sensitivity ; recent cameras were considerably more sensitive than the kinematograph camera.

At the conclusion of the address a film was projected, which had been recorded from the screen of the projection tube on the occasion of the original demonstration.

REFERENCES

1. *Brit. Kine.*, **15**, No. 6, Dec., 1949, p. 178.
2. *Proc. B.K.S. Theatre Div.*, 1945/6, p. 22.
3. *J. Brit. Kine. Soc.*, **2**, No. 2, Apr., 1939, p. 111.
4. See "Picture Definition," by L. H. Bedford, *J. Brit. Kine. Soc.*, **7**, No. 1, Jan./Mar., 1944, p. 14.

DISCUSSION

MR. BEAKS : The removal of the appearance of the line structure in the picture is perhaps more important than the question of the number of lines necessary to impart the required definition.

THE AUTHOR : We have experimented with broadening the lines vertically. The spot of light, instead of going straight across the screen, is wobbled up and down at a frequency of 10 Mc/s., which causes the lines to spread over one another.

MR. R. H. CRICKS : What is the picture brightness in the new system ?

THE AUTHOR : On the 16 ft. by 12 ft. screen it is 7 foot-lamberts. That figure includes the reflection factor of the Stableford screen.

A VISITOR : Can provision be made for downward projection ?

THE AUTHOR : Yes. If we had our own way we would have horizontal projection to the viewing screen. But with the modern directional screens which we are using you can tilt the screen to get the light where you want it. The optical system could be designed for back-projection if desired.

MR. S. A. STEVENS : In kinema projection you have no means of correcting keystone distortion, other than cutting the edges of the screen. In television you could correct it electronically.

THE AUTHOR : You could correct it by distorting the magnetic fields which are actuating the electron beam for scanning. In the pre-war tubes, in which the picture on the front of the tube was imaged, the scanning waveform had to be distorted to correct keystone within the tube. It is necessary only to use an extra saw-tooth modulation. With the mirror projection we have only a very short depth of focus, which is the chief disadvantage ; with a 40 ft. throw, we have less than 9 ins. depth of focus so that the viewing screen should be normal to the axis of projection.

* Cinema-Television, Ltd.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

SENSITOMETRIC STANDARDS

W. Meidinger, *Foto-Kino-Technik*, July, 1949, p. 159.

The merits and demerits of the present sensitometric standards (D.I.N., A.S.A., etc.), are critically reviewed. G. I. P. L.

ON THE RESOLVING POWER OF PHOTOGRAPHIC LAYERS (II)

L. Falla, *Sci. et Ind. Phot.*, July, 1949, p. 241.

Microphotometer traces have been made of resolving power tests showing the diminution of the density difference between light and dark lines as the interval between the lines is decreased. It is suggested that the resolving power may be estimated from the average of the line separations at which the density differences between black and white lines are 0.05 and 0.10. E. W. H. S.

OPTICAL GLASSES AND PLASTICS IN OBJECTIVE LENSES

K. Maas and H. Zolner, *Foto-Kino-Technik*, July, 1949, p. 164.

A survey of the optical properties of glasses and plastics. R. H. C.

CATHODE-RAY-TUBE APPLICATIONS IN PHOTOGRAPHY AND OPTICS

C. Berkley and R. Feldt, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 64.

A survey of numerous applications of the cathode-ray tube, including shutter and flash-bulb testing, measuring the gloss of surfaces, sensitometry and colorimetry, negative grading, sound and television recording, testing mechanical components, etc. R. H. C.

METALLIC-SALT TRACK ON ANSCO 16 mm. COLOUR FILM

J. L. Forrest, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 40.

Means are described for the selective sulphiding of the sound track area. G. I. P. L.

PROCESSING CONTROL PROCEDURES FOR ANSCO COLOUR FILM

J. E. Bates and I. V. Runyan, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 3.

Procedures are described for controlling the various stages in the processing of Ansco Colour film. G. I. P. L.

ANALYSIS OF DEVELOPER AND BLEACH FOR ANSCO COLOUR FILM

A. H. Brunner, Jr., P. B. Means, Jr., and R. H. Zappert, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 25.

Published procedures for black-and-white developer analysis are reviewed. New analytical methods are described or old ones modified to achieve the accuracy required for the complete control of all constituents of the developers used for Ansco Color film. To evaluate the bleach solution prior to regeneration, a procedure is presented for the determination of ferrocyanide ion in this solution. AUTHORS' ABSTRACT.

NOTE ON AN IMPROVED FILTER HOLDER FOR COLOUR PRINTING

T. J. Braun, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 36.

The modification of the printer head of a Bell and Howell Model J printer to accept filters for colour printing is described. G. I. P. L.

FACTORS AFFECTING SPURIOUS PRINTING IN MAGNETIC TAPE

S. W. Johnson, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 619.

Experimental results of the transfer-effect of magnetic tape recording to adjacent layers. The spurious printing was found to depend on the thickness of the tapes (distance effect), recording level, printing time, temperature, and the magnetic characteristics of the coatings. The temperature effect is pronounced, the transferred signal being about 15 db greater for 250°F. compared with 80°F. Most of the printing takes place within the first 10 minutes. O. K. K.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

BULGARIAN PROGRESS IN 1950

During the present year a Kinema Centre will be commenced in Bulgaria, comprising studios with modern equipment for black-and-white and colour films, and for cartoons. The number of kinemas has increased by 200 per cent. since nationalisation.

Bull. du Cinéma Bulgare, Jan., 1950.

QUALIFICATIONS FOR FRENCH PROJECTIONISTS

The examination for the Certificate of Professional Aptitude for the French projectionist includes a half-hour practical test, three one-hour papers, and an oral examination. The certificate is not as yet indispensable for obtaining a licence. *Tech. Ciné.*, March, 1950.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library.

16 *mm. SOUND MOTION PICTURES. By W. H. Offenhauser, Jr. Interscience Publishers Inc.* $10. *Fountain Press Ltd.* £4

The author's object was to produce the first technical guide dealing with 16 mm. sound motion pictures because, as he quite rightly says, " the technical literature of the motion picture is surprisingly sparse and spotty." He has succeeded in producing an extremely comprehensive manual which deals with all the phases of the 16 mm. field. The technical data, which are up-to-date, are augmented by bibliographies referring mainly to material published in the *S.M.P.E. Journal;* the result is a volume from which can be extracted information on practically any technical aspect. Information is easy to find and is presented in a straightforward way.

One aim of the author has obviously been, to show what is necessary to produce and reproduce 16 mm. films of the highest technical quality. Historical surveys, except where necessary to clarify the present, have wisely been omitted. Those engaged in recording, projection, camera or laboratory work will find this book a convenient and authoritative work of reference. The publication itself, with its wealth of excellent illustrations and high-class paper, is of a standard we now rarely see in this country.

H. S. Hind.

YEAR BOOK OF THE ASSOCIATION OF CINEMATOGRAPH AND ALLIED TECHNICIANS, 1950. 128 *pp. Published for the A.C.T. by A. V. Free & Co. Ltd.* 1*s*., *post free*, 1*s*. 2*d*.

Once again the A.C.T. have produced an annual reference book, and on this occasion the word " reference " can be taken seriously. It is quite evident that during the past twelve months, the information has been revised and checked in an extremely thorough manner. The book is entirely free from political bias and propaganda.

Baynham Honri.

FOCAL CINE CHART. W. D. Emanuel. Focal Press. 3*s*. 6*d*.

This small pocket-aid is designed for sub-standard kinematographers. When folded it measures 5 in. by 3½ in., the cover opens up to disclose seven pages of information, including two rotating discs for finding day and artificial light exposure, filter factors and projection distance in feet. Within these covers are a further 16 pages of charts.

Within the limited space this publication is somewhat general and at times a little superficial. Filters are described as " Light yellow," " Dark red," " Light Blue " and so on without further qualification. The chart is evidently designed for beginners, as instanced by two pages, showing the working distances at which to take close-ups.

George H. Sewell.

THE LIBRARY

The following periodicals are required to complete sets for binding in the library: *International Projectionist:* March, 1946; June, 1947; November, 1948; February, 1949. *J. Soc. Mot. Pic. Eng.:* June, 1933; December, 1933; July to December, inclusive, 1935; February, March and April, 1938; March, 1946.

AMERICAN STANDARDS

The following draft American specifications are printed in the February, 1950, issue of the *J. Soc. Mot. Pic & Tel. Eng:*—

Recommendations for 16 *mm. and* 8 *mm. Sprocket Design:* Differs from previous specifications in that pitch of teeth, pitch diameter, thickness of teeth and curvature of tooth face are now calculable by formulae.

16 *mm. Motion Picture Projection Reels:* Establishes dimensions for 16 mm. spools with a capacity of 200, 400, 800, 1,200, 1,600 and 2,000 ft.

CANADIAN STANDARDS ASSOCIATION

A new standard for 16 mm. projectors for industrial and educational use was reported to be in preparation. Work on existing standards was completed.

Consideration was given to a proposal to prepare a standard for 16 mm. projectors for amateur and home use, but it was decided that no action be taken until there was a demand for the standard.

THE COUNCIL

Meeting of 1st March, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), P. H. Bastie (*Hon. Treasurer*), Rex B. Hartley (*Hon. Secretary*), M. F. Cooper, H. S. Hind, B. Honri, T. W. Howard, R. E. Pulman, I. D. Wratten, R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Society Convention.—The President reported that Sir Robert Watson-Watt had agreed to give an address at the Society's Convention on 29th April, on " The Application of Science to the Motion Picture Industry."

Library Committee.—Mr. M. F. Cooper, the Chairman, described the framework for a new system of classification which had been evolved. He also reported on the bulk lending scheme which had been instituted for the benefit of the Provincial Sections and it was requested that this be widely publicised.

Theatre Division.—The Vice-President reported that the meeting arranged for 16th April, had been cancelled, and the Technical Consultant offered to arrange in its place a showing of films demonstrating different colour systems.

Newman Memorial Award.—It was reported that nominations were being considered for the second Newman Memorial Award, and a further joint meeting of representatives of the B.K.S. and the Royal Photographic Society would take place on 20th March.

A.G.D. West Memorial.—The President suggested that Capt. W. Barker's offer of £25 to institute a memorial to the late Capt. West should be expended on an insignia for Presidential office in the form of a chain or medallion, suitably inscribed with the names of Capt. West and Mr. Barker. The President agreed to write to Mr. Barker suggesting this.

Research Council.—It was agreed that the first steps in the formation of such a Council should be to draw up a plan of research before seeking financial support.

Mr. P. G. A. H. Voigt.—It was agreed that the Executive Committee give a farewell luncheon to Mr. Voigt, a Fellow of the Society, and Mrs. Voigt, who were leaving for Canada shortly, especially as a token of admiration for the bravery of Mr. Voigt who was suffering from a spinal affliction.

Committee Meetings.—The President pointed out that future meetings of all Committees would take place in the Society's own premises, and his thanks to the Vice-President for having made available accommodation at the C.E.A. were supported by the Council.

EXECUTIVE COMMITTEE

Meeting of 1st March, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), P. H. Bastie (*Hon. Treasurer*), Rex B. Hartley (*Hon. Secretary*), I. D. Wratten, Miss J. Poynton (*Secretary*) and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

Ernest James Houston (Member), M.B.H. Cine Service, Reading.
Ranald MacDonald (Member), M.B.H. Cine Service, Reading.
Anthony Haydn Willoughby (Member), Sir R. Watson-Watt & Partners, Ltd.
Alan Robert Hutchinson (Member), Essoldo Supplies Ltd.
Leslie Smart (Associate), M.G.M. British Studios.
Victor Baron Lyndon-Haynes (Member), Cineunion Pty. Ltd., South Africa.
Joseph Henry Blackhurst (Member), B.B. Cinema, Lynton, Devon.
John Smethurst Fletcher (Associate), Commonwealth Film Labs. Pty. Ltd.
William Griffith James Vaughn (Member), Visual Communications Ltd.

Resignations.—The resignations of four Members and three Associates were accepted with regret.

COMMITTEE MEETINGS

Finance Committee—8th Feb., 1950

The financial position at 31st December 1949, was considered, and an estimate prepared for 1950.

Journal Committee and Council—15th Feb., 1950

The object of the joint meeting was to consider economies possible in the publication of the Journal.

It was agreed to be undesirable to reduce the number of pages of editorial matter. Suggestions for quarterly publication, for suspension of publication during the summer months, and for increasing the circulation were considered.

Theatre Division Committee—23rd Feb., 1950

Three members were enrolled in the Division.

In view of the poor attendance at the Sunday morning meetings of the Division it was suggested that a number of meetings in the next session be held on Wednesday evenings, by way of experiment. Papers for the next session were discussed.

A vote of thanks was passed to Major C. H. Bell for the assistance he had given the Division in the past.

Library Committee—27th Feb., 1950

The outline of a library classification system was d scussed and approved, it being agreed that the Chairman, Mr. Marcus Cooper, and Mr. Norman Leevers, who had been invited to attend the meeting, should report back.

The accessions were noted as well as the many new magazines received in the Library.

B.K.S. CONVENTION

As previously announced, the first Convention of the British Kinematograph Society will be held on Saturday, 29th April, 1950, at the Gaumont-British Theatres, Wardour Street, London, W.1. The programme will be as follows :—

2.30 p.m. Annual General Meeting of Theatre Division.
3.00 p.m. Annual General Meeting of Sub-Standard Film Division.
3.30 p.m. Annual General Meeting of Film Production Division.
4.00 p.m. Fourth Ordinary Meeting of the Society.
4.45 p.m. Tea.
5.30 p.m. Presidential Address to be followed by presentation of certificates to newly elected Hon. Fellows and Fellows.

A Paper entitled "Application of Science to the Motion Picture Industry" by Sir Robert Watson-Watt, C.B., F.R.S., D.Sc., LL.D., Consulting Scientist to the Rank Research Group ; President, Royal Meteorological Society ; Vice-President Institute of Radio Engineers, New York.

Corporate members only are eligible to attend the Divisional Annual General Meetings and the Ordinary Meeting of the Society. Corporate. Associate and Student members are invited to attend from 5.30 p.m. onwards. Non-members may obtain invitations from the Secretary.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

W. M. Harcourt, Past President of the Society, has recovered from his recent illness which necessitated an operation.

H. J. Leak, whose firm manufactures electronic equipment, is in Europe arranging for the exhibition of Leak apparatus at the Milan Fair.

Louis J. Mannix, President of the Cinema Managers' Association from 1947 until the merger with the Society of Cinema Managers in 1948, last month became National President of the latter organisation.

Bertram Sinkinson and I. D. Wratten were elected the two Vice-Presidents of the Royal Photographic Society at the A.G.M. last month.

Derek Hayson, formerly Editorial Assistant of the Journal, is now with Haynor Ltd., who have presented the Society with a Haynor 16mm. viewing device which is at the disposal of members.

FREDERICK LAWRENCE FUREY

Died 10th March, 1950

As one who knew Lawrie Furey for more than a quarter of a century I welcome this opportunity of paying tribute to his memory. An officer in the Guild of Projectionists, he transferred his allegiance to the Trade Union movement, becoming secretary to the local branch of N.A.T.K.E., a position he filled with distinction for many years. When it was decided to establish a section of the B.K.S. in Leeds, Lawrie Furey was the obvious choice for the position of Hon. Secretary ; his ability and his thoroughness were well-known. *Louis J. Mannix.*

CHARLES FREDERICK TRIPPE

Died 6th March, 1950

Mr. C. F. Trippe, M.I.E.E., for 19 years manager of the B.T.H. Sound Reproducer Sales Dept., was elected a Member of the Society in 1931. He resigned in 1948, two years after his retirement. Born in Newfoundland in 1875, Mr. Trippe was first engaged in this country in the manufacture of radio valves. In the early days of the sound film he played an important role in maintaining liaison between the practical requirements of the industry and the work of his company's research laboratories.

Maker of dreams . . .

To make dreams like this convincing . . . to show them with the smoothness that brings life and reality . . . that is the job of the optical-effects man.

Yet it is only one of his many contributions to modern pictures. By his skill with the optical printer . . . his production of fades and wipes, of dissolves and laps . . . he plays an important part in giving movies their high standard of technical excellence.

If the optical-effects man is to play this part to the full, he must use dependable film of superior quality. That's why he usually prefers to work with the large and well-known family of 'Kodak' motion picture films.

KODAK

Kodak Limited, Motion Picture Film Dept., Kodak House, Kingsway, London, W.C.2.

'KODAK' is a registered trade-mark

PREMIER

ALL-PURPOSE LANTERN
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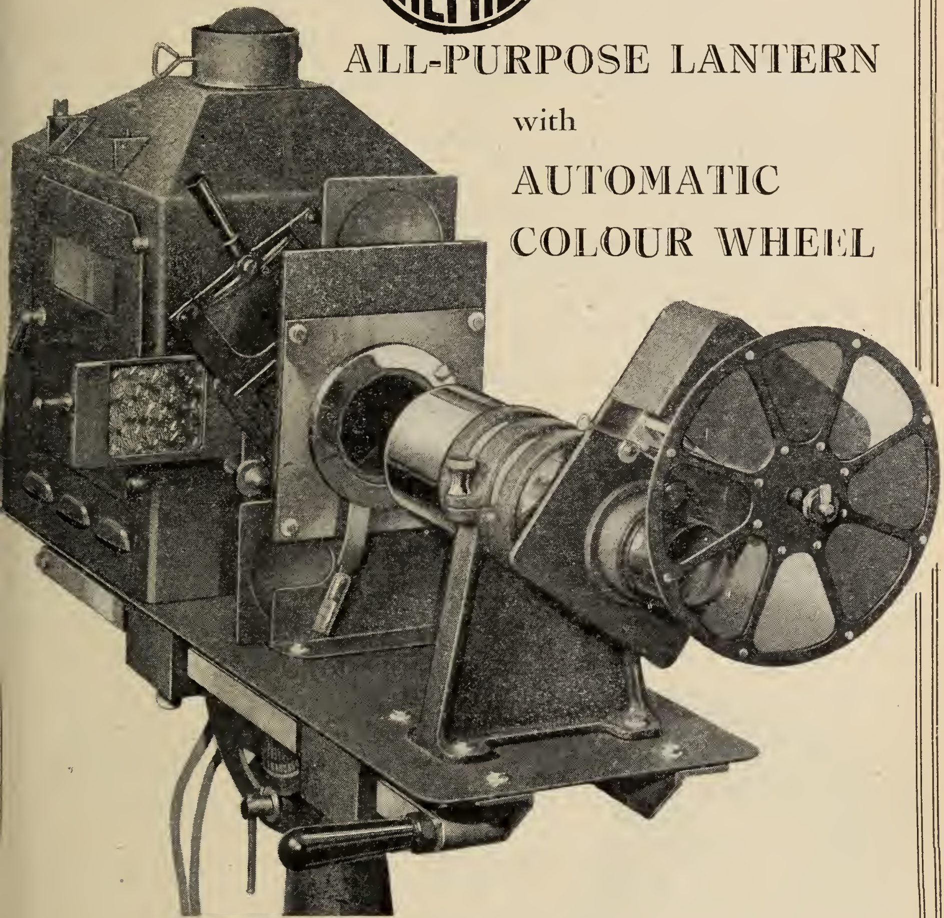

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BRITISH KINEMATOGRAPHY

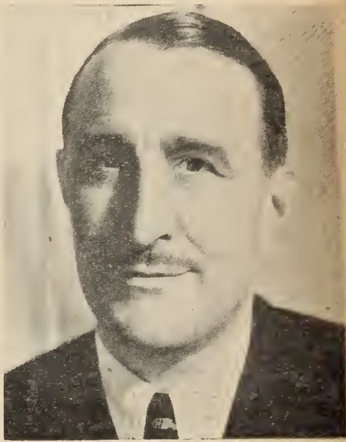
The Journal of the British Kinematograph Society

VOLUME SIXTEEN, No. 5 MAY, 1950

NEWLY ELECTED HON. FELLOWS AND FELLOWS

ICHAEL BALCON

Sir ALEXANDER KORDA



J. ARTHUR RANK

On the occasion of the first Convention of the British Kinematograph Society, held on 29th April, 1950, announcements were made of the conferment of the Honorary Fellowship upon Sir Michael Balcon, Sir Alexander Korda, and Mr. J. Arthur Rank ; and of the Fellowship upon Messrs. H. S. Hind, Baynham Honri, Dr. O. K. Kolb, Dr. G. I. P. Levenson, and Mr. A. W. Warmisham.

The citations will be found overleaf.

H. S. HIND

BAYNHAM HONRI

. K. KOLB

G. I. P. LEVENSON

A. W. WARMISHAM

CONFERMENT OF HON. FELLOWSHIP AND FELLOWSHIP

At the first Convention of the British Kinematograph Society, held on 29th April, 1950, the following conferments of the Hon. Fellowship and Fellowship were announced :

HON. FELLOWSHIP

Sir MICHAEL BALCON

Entered the industry as director of Victory Motion Picture Co., of Birmingham. Subsequently joined Gainsborough Pictures, was appointed director of productions of Gaumont-British Studios, Shepherds Bush. Joined M.G.M. Studios 1937. *Started independent production* 1938. *Now director and head of production, Ealing Studios Ltd.*

For his services to the British film production industry, and in particular for the high standard, integrity and originality of theme and technical treatment of the films produced by him over a long period.

This characteristic has remained in his sound pictures, particularly during and since the war, and one may be certain that pictures of any type produced under his direction possess factual quality. Sir Michael's preference for authentic treatment and backgrounds has led to considerable technical developments which have enabled high quality technical results to be obtained on day and night locations, and with real interiors, for which theatrical representation in a studio might not be entirely convincing.

Sir Michael Balcon's intimate knowledge of film production in all its details, creative and technical, is immense. His grasp of the technique of scripts and direction, of photography, sound and other crafts of the studio are known and respected by all technicians who work with him.

Sir ALEXANDER KORDA

Chairman, London Film Productions Ltd., Alexander Korda Film Productions Ltd.

The contribution by Sir Alexander Korda towards the betterment of British motion pictures cannot be over-estimated for it was entirely due to his production of " The Private Lives of Henry VIII " that international screen time was first given to pictures made in this country.

Born in Hungary, Alexander Korda's first profession was that of a journalist, but he soon became interested in motion pictures and worked as a director for the Ufa Organisation in Germany. From there he went to Hollywood where he made some well-known pictures, and arrived in this country in 1930 to direct a picture called " Service for Ladies " for Paramount.

In 1931 he formed his own company, London Film Productions, and proceeded to make pictures which at that time rated amongst the finest produced, such as " The Private Lives of Henry VIII," " The Scarlet Pimpernel," " Catherine the Great," " Elephant Boy," " The Ghost Goes West," " The Shape of Things to Come," etc.

In 1934, plans were made for the building of Denham Studios, the most forward step in British studio construction that this country had ever known, because here was an organisation which could compare most favourably with any studios either in Europe or in America and with unrivalled technical facilities. In 1936, these Studios together with Denham Laboratories were put into operation.

His recent achievements in the art of motion picture making are well known, as also is the fact that he is now in control of and has completely modernised the British Lion Studios at Shepperton and Worton Hall ; but it is on his technical ability that this citation for the conferment of Honorary Fellowship is mainly based.

No director has higher technical qualifications, or is more conversant with the problems encountered by the various technical departments in the making of a motion picture. He has absolute and complete knowledge of the major technical requirements of each of the processes, whether it be photography, laboratory, art direction, music, script writing, sound, editing or make-up, and has such technical knowledge that he is able personally to decide the requirements of each and all departments for any particular effect needed.

Pictures directed by him are noteworthy for their extremely good camera angles, for the high standard of editorial work and overall polish which can only be achieved by a person having the most intimate knowledge of technicalities.

JOSEPH ARTHUR RANK, D.L., J.P.

Educated Leys School, Cambridge. Chairman Odeon Theatres Ltd., Gaumont British Picture Corporation Ltd., British & Dominion Film Corporation Ltd., General Cinema Finance Corporation, J. Arthur Rank Organisation Ltd., Circuits Management Association Ltd., etc., etc. Managing Director Joseph Rank Ltd. Director of Eagle Star Insurance Co., Ltd. President

British Film Producers Association. Elected life member Academy Motion Picture Arts and Sciences. Honorary Doctor of Laws, Boston University, Boston, Mass., U.S.A.

Mr. Rank founded the Religious Film Society and produced films of religious teaching for churches of all christian denominations. From this early start his interests expanded to commercial motion pictures, and together with the late Mr. C. M. Woolf he founded General Film Distributors in 1935.

During that period he was one of the principals interested in the building of the Pinewood Studios at Iver Heath, Bucks. He later widened his activities to embrace film production, and in 1941 acquired control of the Gaumont-British Picture Corporation Limited, with its studios and theatres. The Odeon Group of theatres soon came under his control, thereby assuring a large exhibition potential for pictures made under his auspices. The acquisition of Denham Studios gave his group of companies every facility for the making of large-scale motion pictures.

It may be safely said that had it not been for J. Arthur Rank there would be little or no motion picture production business in this country to-day. In the darkest days of the war, when a deep depression had descended upon the Industry, he had the courage and conviction that British pictures should and could be made. The pictures made during this period proved that the British technician was capable of a product second to none, both technically and from the point of view of entertainment. Mr. Rank's untiring effort has brought a new stability and a fresh vision into the Br tish Film Industry, and given encouragement and opportunity to some of the best directors and producers we have to-day.

The above may give the impression that Mr. J. Arthur Rank is purely and simply a financier, but nothing could be further from the truth, for in general terms Mr. Rank has done more for the advance of technical and scientific progress in the motion picture and allied fields than any other man in recent years. His untiring encouragement of research, both morally and financially, has in no small measure placed us in a position where we no longer require to take second place in the world. The developments which have taken place under his guidance during the past years show a deep knowledge of the problems which beset the Industry in all its aspects.

His untiring efforts and his vision regarding progress in scientific matters are exemplified by the many improvements that have taken place in recent years, not the least of which is the predominant position we hold in large screen television, for which he gave *carte blanche* to our late friend and Hon. Fellow, Captain A. G. D. West.

It can be surely said that Mr. J. Arthur Rank of necessity has a large overall technical knowledge in order to have brought to fruition the many things that have so amply proved the skill and assiduity of British designers and manufacturers who work under his auspices.

FELLOWSHIP

HAROLD STANLEY HIND, A.M.I.E.E.

1929-1937 *Western Electric Co.* 1937 *onwards Maintenance of Studio Camera and Equipment Sound Services.* 1945, *Operating Manager and Director : Sound Services Ltd.*

For his technical work over a period of 20 years in the furtherance of the sub-standard and non-theatrical film, the production of specified type of equipment and the large-scale organisation of non-theatrical projection. Attention is drawn to his pioneer work in 16 mm. standardisation.

BAYNHAM HONRI

1923-1928, *B.B.C.* 1928-1929, *Chief Sound Engineer : Gainsborough Pictures.* 1930-1936, *Chief Sound Engineer : Twickenham.* 1937-1939, *General Manager, Stoll Studios.* 1940-1945, *War Office and Admiralty.* 1946, *Studio Manager, Ealing Studios.*

Mr. Baynham Honri has had 21 years' experience in the Film Industry, preceded by five years' experience in the B.B.C. Engineering Department. He was a pioneer in the application of sound to motion pictures, and carried out much original work on this subject and on the development of acoustics and of microphones in the B.B.C.

OTTO KURT KOLB

1926-1927, *Technical Manager, Poulsen & Co., Germany, and Electrical Fonofilms Co., Copenhagen. Introduced and developed British Acoustic Sound System in this country in* 1929.

Dr. O. K. Kolb played an important part in the early developments of sound recording, from the pioneer work of Poulsen and of the Klangfilm system, to the practical development of the British Acoustic system, and recently the application of magnetic recording to the film industry. As Technical Consultant and Patents Advisor to the Rank Organisation he has guided technical policy in many fields other than sound.

GERALD ISAAC PASTERNAK LEVENSON, B.Sc., Ph.D.(London)

Nine years' experience with Mr. I. D. Wratten and Motion Picture Technical Service Dept., Kodak, Ltd. Photographic research chemist and technician. In charge of processing chemistry group in Kodak Research Laboratories.

For his research work into the chemistry of development and in particular its application to the motion picture field, which has resulted in both new and modified approaches to the chemical analysis of processing solutions. His work is being applied to practice at both major American motion picture laboratories and in English and French laboratories.

ARTHUR WARMISHAM, B.Sc., M.Sc.

Optical Director, Taylor, Taylor & Hobson, Ltd. Fellow of S.M.P.E., Fellow of Physical Society, Fellow of Institute of Physics.

To his pioneer work in lens design is chiefly due the world-wide reputation enjoyed by British optics. Lenses designed by him are used for the photography of a large proportion of the world's professional film production and much sub-standard film work. His optics are largely responsible for the success of the Technicolor process, while his development work in projection lenses has considerably raised the standards of optical projection.

Silver medals were presented to Dr. Levenson for his paper "Controlling the Elon-Hydroquinone Developer" (Brit. Kine., **12,** *No.* 2, *Feb.,* 1948), *and to Mr. Warmisham for his paper "Transmission Calibration of Photographic Lenses" (Brit. Kine.,* **14,** *No.* 4, *April,* 1949).

The Convention will be fully reported next month.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library.

HOW TO PROCESS. L. J. Wheeler. Focal Press. 6*s.*

Always provided that one has the need or the desire to process one's own 16 mm. films, the advice that Mr. Wheeler gives is both practical and sound. The construction and use of a small portable drum-type machine is described step-by-step in both word and picture, and is such a way that no one with experience of ordinary D. and P. can reasonably go wrong.

The discerning reader will be careful to note that, while the author makes the whole thing look surprisingly easy, he does also stress the need for careful control throughout all stages of handling the film, and it would be folly to ignore the recommendations given. The addition of an anti-fogging agent to the developer solution would undoubtedly help to minimise the danger of aerial fog that is to be expected with the type of machine described and this recommendation could with advantage be made in future editions of the book.

R. H. Bomback.

THE FILM INDUSTRY IN GREAT BRITAIN. Compiled by the British Film Academy. F. W. Kahn Ltd. 2*s.* 6*d.*

Designed simply as a useful collection of known facts and figures about the British film industry this little book is very successful in presenting what its Introduction claims. Collected together for easy reference the contents were "never intended to be a complete and original survey of the industry," but a report of material made available by the responsible organisations. Among data, up to December, 1949, not easily available elsewhere, is that on children's films, world markets for British films, specialised exhibition and censorship.

A. W.

PHOTOGRAPHY IN SCIENCE, ART, AND INDUSTRY, 1950. *Special Number of the Photographic Journal.* 4*s.*

This book gives details of the progress made during 1949, in the field of photography, by G. E. Matthews, F.P.S.A., F.R.P.S., in kinematography, by R. H. Cricks, F.B.K.S., F.R.P.S., and in photo-engraving by H. M. Cartwright, F.R.P.S. The article by Mr. Cricks deals with all aspects of kinematography as it affected the technician during the past year.

A. R. R.

MUSICAL TREATMENT OF FILMS

Read to a joint meeting of the British Kinematograph Society and the British Film Academy on 4th January, 1950

I. COMPOSITION

Ernest Irving*

SOME time ago Dr. Hubert Clifford gave a very interesting paper upon the technique of fitting music to pictures.[1] The subject of this evening's papers is the more intimate and spiritual relations that exist between musicians in contact with producers, directors and editors.

Mr. Mathieson and I start with some principles in common. What is called " background music " must be regarded as ancillary in its function, and must be at all times subordinate to the needs of the action of the film. It is unlikely that this will allow normal symphonic development, which demands a logical relationship between its parts, since most films are episodic and fly wildly from Pimlico to Paris, and from Kind Hearts to Coronets.

But there are two underlying principles which Mr. Mathieson has practised over many years, and in which I have faithfully followed and supported him. The first is that, other things being equal, one might as well have the most accomplished musician to write the score, as when it has come through the batterings of direction and editing, there will always be some musical content left which will give class and style to the picture, even if its effect is confined to the subconsciousness of the listener. Secondly, we feel that a British composer is as good as a foreigner for a British film.

Development of Film Music

Before I became a neophyte in the film world, knowing practically nothing whatever about it except the recording side, I had practised for thirty years or so in the theatres, writing incidental music for all kinds of plays from Shakespeare down to " The Circle of Chalk," and was lucky enough, with Mr. William J. Wilson and afterwards with Mr. Basil Dean, to gain experience in the making of sound films without committing any major blunders. In those days the cost of the film was about one-tenth of the present average, and the music was on a small scale, and played by a small orchestra.

When Sir Michael Balcon came to Ealing Studios, music was released from the financial strait-jacket which had so far cramped its style. William Walton came in to write the score for " Next of Kin," and showed an adaptability and dramatic sense remarkable in a composer of such originality. Up to this time I had written most of the incidental music myself, but was now able to suggest the employment of composers who had made their reputation on the concert platform, and to give them adequate orchestras to perform their work.

We had another score from Walton, followed by one from Dr. Gordon Jacob, three from Lord Berners, two from Frederic Austin, two from Alan Rawsthorne, one magnificent epic " The Overlanders " from John Ireland, and finally " Joanna Godden " and " Scott of the Antarctic " from that grand old man of British music, Dr. Vaughan Williams. Interspersed with these famous masters of concert music came John Greenwood with four fine dramatic scores, Richard Addinsell, Clifton Parker, Norman Demuth and Leslie Bridgewater ; while the foreign element was supplied by five *genre* pieces by Georges Auric.

All these scores were settings for full orchestra, and Ealing has employed the London Philharmonic Orchestra, and later the Philharmonia, with most gratifying results.

* Ealing Studios, Ltd.

The Composer's Approach

The composer, having read the script, will have formed some ideas as to the character of the music he is to write, and will probably make some sketches. The composition cannot be finished until the picture is cut, and even then it is subject to continual alteration to which I will refer later. Some composers work very quickly, others, like for instance John Ireland, are slow and timorous. In my capacity as Music Director I do my best to help bring the personality of the composer into direct touch with his job, and to explain the modifications necessary for successful dubbing.

Dr. Clifford in his lecture mentioned Vaughan Williams' music to " Scott of the Antarctic." Immediately it was decided to make " Scott " I suggested that Vaughan Williams was the one man in the world to compose the score, if he were willing to do it. I sent him the script and at a conference at Ealing he described his musical scheme in detail. It was approved with enthusiasm, although at that moment nothing existed of the picture, except a few location shots. About a fortnight after this conference, I had sent to him some rough timings of the scenes. Vaughan Williams had, however, already sent pianoforte sketches and the full score of the entire work—about 50 minutes of music, scored for an orchestra of 80 and covering all the dramatic scenes. Naturally, all this music was not included in the film, but in my opinion too much of it was cut.

How closely the composer got to the spirit of the film is shown by this extraordinary and, in my experience, unique development. He had written Main Title music for which his only direction from me was that it must last about 130 feet ; it described the struggle of man against nature. The music was dubbed over the scene of climbing the Great Glacier, which, of course, the composer had never seen. It fitted absolutely : not a note was altered.

Provided the right composer is agreed upon it is a comparatively easy matter to get his music fitted and the orchestration modified to fit the picture for the recording sessions. Directors vary very much in their musical ideas, and while some of them are abashed by the psychological heroism involved in criticising music in front of 80 musicians, others cheerfully suggest changes that would take a week to make. I am fortunate in working with a sympathetic and musical Chief of Sound, Mr. Stephen Dalby.

Accuracy of Timing

We have not, so far, made at Ealing any film which demands the use of click-tracks and the other mechanical gadgets beloved by Hollywood. I am against any delegation of authority which in any way lessens the control of the conductor over the sound that goes on to the track.

A year or two ago a mission was sent to Hollywood and came back with full details of American methods in the recording studio. It seemed to me that if these were put into full effect, all the conductor would have to do would be to listen through earphones to the pips, and beat the correct number of beats in the bar. Now I agree with Malvolio in his criticism of Pythagoras, I think nobly of the human soul and in no way approve of fettering it with mechanics of this kind. The reaction between the conductor and the orchestra, and even more the reaction of the members of the orchestra to one another, is far more valuable and important than dull, hidebound mechanical accuracy. May I explain my own methods of achieving synchronisation.

Timing Sheets

The composer having been decided upon, I see the picture with him in company of the director, producer and editor, and discuss where the music should come and what kind of music it should be, and timing sheets are prepared by the editorial department, giving fullest details of the action and all important points of synchronisation. Later on, when the composer has made some sketches they are studied, trimmed and reshaped where necessary, and final or "pink" timing sheets are issued. When the full score arrives, any points where absolute synchronisation is required are marked to a third of a second. An average metronome tempo is specified between these points, which determines the general flow of the music ; between the fixed points the music may flow naturally with rubati—slight fluctuations of tempo where the music or the action calls for them.

Parenthetically, it is much better to cut or extend the music to fit the picture rather than to hurry or drag it out. The music thus grows to fit the action like the music fits the words of a song, and avoids rigidity and squareness of outline, both of which can be very disturbing, and which in point of fact in some American pictures I have seen I found very disturbing indeed. To "Disney-ise" action is very good for a Disney, but not at all good for music which has to make its principal appeal to the subconscious.[2]

At recording sessions a representative of the editorial department with a stop watch is invested with rigorous authority to reject a take where the agreed important synchronisation points are inaccurate. Generally, 10 or 12 minutes of printable track is recorded during a three-hour session.

II. SCORING AND RECORDING

Muir Mathieson*

A FILM MUSIC DIRECTOR must have a wide musical knowledge and general experience to be able to contend with the numerous problems that arise. Films have covered the whole range of music from symphony to swing, music halls to madrigals, brass bands, pipe bands, street bands, drawing-room ditties and barrack-room ballads, hand organs, steam organs, barrel organs, solos, duets, choirs, quartets—in fact, with the resurrection of the zither, I can think of nothing that has been left out.

Naturally, there is little likelihood of a music director acquiring a vast practical experience of, say, the bagpipes or the barrel organ, but a working knowledge is essential.

That is one side of the requisite musical experience ; another is the purely technical one of fitting music to films. This is the most spectacular part of the conductor's business and always looks the most difficult, but that, I think, is misleading. With preparation, careful planning and a stop-watch, any intelligent person should be able to beat time and fit so many beats into so many seconds. The musician's problem is to do that, and still keep the flow and sense of the music.

British Composers

At no period during our history have we had such a wealth of fine composers. To-day, they lead the world. I believe that films have helped them into this position of pre-eminence. Wardour Street has become the modern patron of the struggling composer, notwithstanding that the allocation for music composition is only about one-quarter of one per cent. of the total budget. This modern patronage has enabled the composer to earn a living, gain experience and so concentrate a little more comfortably on his operas, symphonies or quartets. In return, he brings to films the benefit of his ever-growing experience and musical culture.

The old argument about prostituting his art by writing for films is luckily dead. It is no different, presumably, to write music to order for J. Arthur Rank

* J. Arthur Rank Productions, Ltd.

or Sir Alexander Korda, than it was to write for the Esterhazys or the Archbishop of Salzburg.

Arthur Bliss, one of the pioneers of British film music, wrote the score for " Things To Come " in 1935. Since then we have had scores from practically every composer of note in this country. It is interesting to look back on their first reactions. Some were only too anxious to try their hand at the new medium ; others were a little diffident ; while most of them were nervous about the time factor. This nervousness was only overcome after they had first experienced the stimulation of the film visual on the musical imagination. No composer that I can remember has ever refused to do a second score.

Unlike any other country, we have always given a fair chance to foreign composers, but I must stress that our first duty should be to exhaust all the possibilities at home before looking farther afield.

Fig. 1. Dubbing Session for " Hamlet," on the Scoring Stage of Denham Studios, showing Footage counter to left of Screen.

Ancillary Recording Equipment

Stage One at Denham Studios was only acquired by the Sound Department after a long battle in 1946, and converted into a permanent Music Theatre. With it went a permanent crew of technicians, whose work is seldom fully appreciated, except by the people who use the music recording stage. The studio has developed into one of the most efficient recording outfits on this, or I believe, the other side of the Atlantic. In its conception was considered every possible technical device which would simplify the questions of balance and synchronisation, and leave the musicians free to concentrate on making music. An effect is that less footage is shot than formerly ; but the footage that is recorded is the track that is going into the finished picture, approved by the composer, the orchestra, the editor, the sound mixer and finally the director or producer and myself.

Two of the devices at Denham are known as the " ticker " and the disc playback. The " ticker " is a seconds-counter, which is placed in full view of everyone, at the side of the screen (Fig. 1). This avoids the endless clicking of numerous stop-watches during a take and the inevitable arguments that follow.[3]

Use of Disc Playback

In considering how the disc playback helps the various people involved in a music session, we may start with the Music Director. He is the link between the film technicians with their sequences, cuts, dissolves, and the musicians, with *their* crochets, quavers, seques, ritenutos and fugal developments. He naturally holds a watching brief over the various problems that may arise as between composer, director, sound mixer or editor. Once he has a " take " on disc it can be played back any number of times : details of synchronisation and balance can be settled, without the orchestra playing incessantly. The disc may be used instead of the orchestra for rehearsal purposes. An orchestra, after all, is human and while it can and will work for any length of time, there comes a moment when the excitement goes from the playing. It is usually the moment when the players begin to know a section too well and become bored playing it.

The disc playback not only helps the orchestra and the music director, it enables the editor and the sound engineer to express their views *at the time*, as to whether any of the orchestration is likely to interfere with their final dialogue or sound effects tracks. This normally cannot be settled until the picture is in the re-recording theatre. By this method the need for re-takes is reduced to an absolute minimum.

Selection of Takes

The composer has a chance of demonstrating, rather than trying to explain, what he has in mind, and the director can have, what is in effect a rough dub of his picture, within one minute of recording—that is, he can see the recorded sequence with the music and dialogue mixed. Within about two minutes if he wishes, he can have the effects track added. Thus he is able to judge the full and final effect of any sequence long before the picture reaches the re-recording theatre.

Time is saved on the selection of takes. The O.K. take is the only one printed. This playback system has been proved absolutely invaluable in creating unusual orchestral effects. Often we have added two or three additional music tracks to a basic one to give a fuller or more stereophonic effect.

On one occasion we were able to hear an original voice track, played back with three different accompaniments—the full orchestra, then a track of all the violas, clarinets and cellos in unison, and finally the upper strings divided into four very high parts. The effect staggered even the orchestra.

III. POST-SYNCHRONISATION AND EDITING

Ernest Irving

IT is the last stage of the musical treatment which is most troublesome, and the higher the class of the music the more hazardous its passage through the rapids of cutting and dubbing. The pink sheets are alleged to express the final form of the picture, and on very rare occasions may prove to do so. More often the editor continues to cut and reshape his picture for weeks after the music is made.

The composer may have tried to preserve some kind of musical form by using a theme with variations, or he may have employed the Wagnerian principle of using a *leit-motif* for each character and combining them according to the action. In the first case he can be reasonably certain that the theme will be promptly removed, and the first thing heard will be variation No. 3. In the second case the labels will be taken off at the entrance of the characters so that they mean nothing whatever when used in combination. The fact is that the director and the editor play for safety all the while. They agree to, and indeed ask for, music over every dramatic sequence, but when the film is cut, if they think any scene can stand by itself the music is ruthlessly eliminated.

Second Thoughts

One of Ealing's best and most successful films had a score by one of England's most famous composers. After the first recording session the director, a man of great talent and strong personality, submitted twenty-eight reasons why the music should kill the picture. I am referring to " The Overlanders," with music by John Ireland, his first venture into films. It was recorded at H.M.V. Studios without the picture. I show it as an example of two things : that contrapuntal forms may be used without damaging the film, and that the closest synchronisation can be given to dramatic music without projection of the mute, if the preparatory work I have outlined be carefully carried out.

In a further example, the music written for the scene was cut out, though it was used in another place in the picture. It formed part of Vaughan Williams' score for " Scott," and it was removed on the ground that it was too tragic. When the composer was told this, he instantly wrote a second and quite worthless piece of music, and sat up half the night copying out the 60 orchestral parts—a feat of heroism which was quite wasted, because I would not even play it through, standing out for the original or nothing. The result was nothing.

As I remarked at the beginning of this talk, and as my colleague agreed, all these discussions and arguments are valuable, and however distasteful to the musicians concerned the results are frequently of great advantage to the picture. For this we, at Ealing, have every reason to be grateful to Sir Michael Balcon, who keeps all the strings of control in his own hands, and balances the claims of the various departments to the eye and ear of the general public, of whom it must be remembered that only a very small percentage is musically educated, and some are even haters of music.

Examples of Post-Synchronisation

As an example of post-synchronisation, I should like to show a sequence from Leslie Bridgewater's Piano " Concerto," used in the comedy section of " Train of Events." A symphony orchestra was conducted by a non-musician and the solo part played by a famous dancer completely ignorant of the piano. The players are what is very ungratefully described as " dummies," in fact the whole thing is completely bogus and synthetic. The actual sounds are made by Miss Irene Kohler and the Philharmonia Orchestra. A slight change in pitch is due to the fact that the two parts of the music were made in different temperatures. I did not venture to remake it because Miss Baronova's synchronisation was so accurate that it would take more time than we could afford to get as close as that to the illusion.

The papers were illustrated by the projection of sequences from : " Whisky Galore," " The Overlanders," " The Loves of Joanna Godden," " Scott of the Antarctic," and " Train of Events."

REFERENCES

1. *Brit. Kine.*, **15**, No. 3, Sept., 1949, p. 86.
2. See *Brit. Kine.*, **11**, No. 4, Oct., 1947, p. 117.
3. See also *J. Brit. Kine. Soc.*, **2**, No. 1, Jan., 1939, p. 47.

DISCUSSION

Mr. R. H. Cricks : Do the authors regard it as desirable to have background music behind dialogue ? By the time the print has reached a late run, the intelligibility of the speech is seriously affected.

Mr. A. W. Watkins : If it sounds good in the West End, there is no reason why it should not sound good in the Provinces. But I do think it is about time that the B.K.S., with its consultant Mr. Cricks, carried out a little research into these matters. If the standard of projection, whether of picture or sound, were raised, the work of the studio would be shown to better advantage.

Mr. Irving : The question of incidental music behind dialogue is highly disputable. Often the real reason why music behind dialogue is not successful is that it is the wrong kind of music. The audience cannot listen to a tune and to dialogue at the same time. Often the sound is run at too high a level. Music behind dialogue is always arguable unless you really need atmosphere which cannot be suggested in any other way. I should think it outrageous to put music behind the words of Shakespeare except where it can be reasonably deduced that he himself used it.

Mr. W. S. Bland : Background music for news is, owing to the time factor, always taken from the library, and cannot be scored to fit the commentary. In regard to the level of reproduction, I think the main factor in unintelligibility is not wear and tear of the film, so much as the fact that the ear does not act in a linear manner, so that balance is disturbed when the level is altered. Newsreel commentaries are usually delivered fairly forcefully, and if the tracks are not reproduced at a similar level in the theatre, but at feature dialogue level, the desired effect is lost.

Mr. Clive Donner : What is the opinion of the authors in regard to the use of a small ensemble ?

Mr. Irving : If you want the effect of a big orchestra, you must employ an orchestra of that size. We usually employ about 60, but there is seldom necessity for more.

Mr. Mathieson : Basically the problem is that in the orchestra you have three or four sets of sound—wood-wind, two lots of bass, and strings. In the wood-wind, the normal way of writing is for two flutes, two oboes, two clarinets, and two bassoons. If you cut down any of these, you get a crude effect of four instruments making a chord. In the same way, you cannot get tone with one horn, nor even two : you need four. The same thing applies to brass tone. Then you need percussion. If, of course, your sound engineer could make the sound of a quintet balance with the rest of the players, then you could produce a full orchestra sound with 23 players. But it does not work like that ; you need 45 or 50 players to make a full symphony orchestra sound.

Mr. C. Donner : What I meant to suggest was that a small ensemble should be used for its own sake, not to sound like a full orchestra.

Mr. Mathieson : Any small arrangement will always sound like a specialised group of instruments.

Mr. Peter : Does Mr. Irving find it better in recording vocals to record a play-back with piano and add the orchestra after, or does he think it better to record with the full orchestra ?

Mr. Irving : I value very highly the interaction between the orchestra, the singer, and myself. Unless I am compelled for technical reasons, I do not like to record two tracks separately. It is not so bad with rhythmic numbers, but for any music with emotional content the singer and orchestra should be able to hear one another.

Mr. Mathieson : I normally shoot them separately for convenience in cutting. If the singer and orchestra were kept in one shot all the time, there would be no problem ; but when going into close-ups, obviously the perspective between orchestra and singer must change, and I have found the only way of doing that is to shoot the singer first with a piano accompaniment, and then put in the orchestra.

Mr. L. Knopp : The aesthetic value of a picture and its accompanying music is determined by the producer in the intimate confines of the theatre in the studio. Is it considered what would be the background noise in the average kinema seating between 500 and 2,000 people ? Quite apart from the value of the music from its dramatic point of view, a certain level of sound is necessary to overcome the noise of the audience.

Mr. Irving : You may want silence, but you will not get it. Silence means simply people opening packets of sweets and coughing, and the noise of the projectors. If I wish to express silence, I always try to get a loud noise and then a very low noise, which gives much more the effect of silence than if you had no noise at all.

MAINTENANCE OF 16 mm. PRINT QUALITY

Read to the British Kinematograph Society Sub-Standard Film Division on 11th January, 1950

I. THE RENTER'S PROBLEMS

E. F. Bradley, M.B.K.S.*

IN the past, some interesting papers have been given dealing with material for making release prints from 35 mm. production, particularly regarding sound.[1] It is generally agreed that a re-recorded track with a 16 mm. sound characteristic is preferable to a reduction print made either direct from a 35 mm. negative or by using a 16 mm. dupe.

The modern laboratory is efficient within present-day standards when making 16 mm. release prints, providing suitable material is available from which to make them, although on some occasions it is necessary to return sections for reprinting, due to faults which have been discovered on projection. An old argument is whether a renter of 16 mm. films should have to project each copy when received from the laboratory, thereby increasing overheads. In most cases the laboratories guarantee that all prints have been projected, and the necessary replacements made, so it would appear rather a waste of time and money in making a double check.

Waxing

The emulsion should have been suitably hardened. Waxing is to be strongly recommended, although opinions differ whether the additional outlay is justified. From tests between waxed and unwaxed prints, the following information has been obtained :—

(*a*) If a print is going to be slightly damaged by scratching, waxing may save it, as the scratch may only penetrate the wax ; but if that scratch is fairly deep, then the film will be damaged whether it is waxed or not.

(*b*) Waxing will assist in the projection of new prints and often save perforation damage.

(*c*) If the gate pressure in projection is not correctly adjusted, waxing will often save a print becoming seriously damaged, especially when new.

(*d*) The cost of having a print waxed is only a fraction of the normal cost of one hire.

Storage

In most libraries, 16 mm. film is stored on spools, and it is immaterial whether the stock is placed vertically or horizontally in the vaults. Temperature should be at 60°F. and the atmosphere should be fairly moist.[2]

There is no standard of tolerance laid down for the shrinkage of a 16 mm. film, but I gather from Messrs. Kodak Ltd. that a film with a shrinkage of between 0.5 and 1 per cent. should not prove difficult to project. Where possible, it is wise to store a print for two or three weeks before shipping.

Despatch

The question of despatch next arises, and here our main problem is weight. The majority of film to-day is sent through the Post Office, and no parcel can be despatched which exceeds 15 lbs. ; in most cases this means that two packages have to be used for the average feature film. The weight of a 16 mm. film per 1,000 ft. is approximately 32½ ozs. which based on a 4,000 ft. feature, means that 8 lbs. will be taken up on film alone. This leaves 7 lbs. for spools, metal or cardboard containers and packing, etc.

Some manufacturers have experimented with a type of centre bobbin and lightweight stays, which would hold a roll of film together so that the centre would not fall out. When the film is received by the exhibitor, it would be

* Formerly Metro-Goldwyn-Mayer Pictures Ltd.

placed on split spools specially made to fit the bobbins. However, it will be a long time before this can be put into practice, if ever, due to the various categories of 16 mm. exhibitors.

Inspection Routine

The main problem with inspection routine is to combine economic working costs with efficiency—which brings us to the almost unanswerable question "How long should it take to inspect a 16 mm. library sound print?" Naturally, this depends on the state of the print and on the speed of the examiner. If modern equipment is used with an efficient examiner, it should take approximately 15 minutes for a 1,600 ft. spool, providing of course no major repairs are necessary and the film is in good condition.

A system of coding is useful, and an individual report should be kept of the condition of each film prior to despatch. It is a good plan to file this report away from the film, so that the following inspector cannot copy it, but has to concentrate on making her own individual examination.

Economies can be made by "cannibalising" one print with another. Although this takes some time in matching, it will avoid a copy being taken out of circulation for reprinting. In this respect it would be very helpful if 16 mm. stock could bear a footage number similarly to 35 mm., thus enabling the sections to be more easily identified. A machine has been manufactured for marking release prints,[3] but nothing is yet available for marking a 16 mm. or 35 mm. negative, in such a way that the marking will print through to the release copy.

Life of Prints

How long does a 16 mm. library print last? My practical experience, which may differ from that of other people, is that once a black-and-white film has had ten screenings by different projectors and projectionists and has come through without trouble, it seems to continue its successful life for possibly 70 shippings or 150 screenings. Figures are given in terms of shippings, as it is difficult to estimate what actual work a print has had.

About 600 screenings have been obtained from one film on a continuous daylight projector[4] before it has had to be junked. This figure is based naturally on the same projector being used; there is no doubt that a film does not last so long if different projectors and projectionists are employed.

Basic reasons for film mutilation come under two headings: perforation damage and scratch or rub damage. First let us consider causes of perforation damage in projection.

(*a*) A bent spool which might throw the film off the projector sprockets.

(*b*) Incorrect lacing.

(*c*) Worn sprockets and intermittent claws.

(*d*) Incorrect adjustment of the take-up clutch and feed spool tension.

(*e*) Slack film between the feed spool and the first sprocket. Also between the take-up spool and the last sprocket.

(*f*) The pull-down of the projector claw being too abrupt when starting. The projector may be started on silent speed, and then switched over to sound, providing of course such a switch is fitted to the projector.

(*g*) Parts of the projector not revolving which move by the tension of the film passing over them.

A simple method of detecting perforation damage whilst projecting, is to feel the film just before it is wound on to the take-up spool to check that the perforations are not being pulled. If this were done at frequent intervals, hundreds of feet of film damage would be avoided.

Scratches

Causes of film scratching may include the following faults:—

(*a*) Dirt or hard emulsion in the film channels of the projector is the most effective method of destroying a film. It is a good thing to run a short length of plain black film through the projector to see whether it is being marked. If it is, the offending part can be detected by tracing where it is on the film and comparing it with the film channels.

(*b*) Excessive picture gate pressure.

(*c*) Projector sprocket guards out of line.

The re-winder is another hazard that can cause trouble with the inexperienced or careless operator, especially if a ring is worn on an ungloved hand.

To conclude, I must thank Metro-Goldwyn-Mayer Pictures Ltd. for permission to screen the films used for demonstration purposes.

II. PROBLEMS IN THE FIELD

Matt. Raymond, Jnr., M.B.K.S.*

A PRINT in service is no better than the worst treatment it has received, and in order to maintain prints in first-class condition it is essential for the exhibitor to co-operate with the renter by keeping his equipment correctly adjusted and clean.[2]

Films can and will be damaged by any projector if it is not threaded correctly or if the projector is not kept clean. If dirt is allowed to accumulate, scratches will occur when the film passes through the gate, and also if rollers are stuck or not able to turn freely.

The tension adjustment and construction of projection gates have an important bearing on the life of a print. If all film supporting or guiding surfaces were perfectly smooth and constructed of a suitable glass-hard material, there would be little trouble.

Another source of damage is projector gates which on close examination can be seen to have minute scratches, caused through dirt and wear, or perhaps by the use of a pin or some metallic instrument for cleaning purposes. These scratches can lead to an enormous amount of trouble. Only bone or wood of course should be used for cleaning.

Non-Stop Projection

It is a debatable question whether a complete programme of, say, 2 hours' duration or more, should be run non-stop on one machine. This is a practice which is growing very rapidly and is causing a certain amount of concern.

Apart from the various non-stop projection devices which are on the market,[4] a number of exhibitors indulge in methods of their own in order to run their programmes non-stop. One method is to assemble the whole programme on a large spool and take up the film on a normal 1,600 ft. spool. In order to do this they insert about 1 in. of spacing between each 1,600 ft. reel when assembling the complete programme, cut the spacing when it has passed through the projector, and then take up on a fresh spool. Sometimes in their haste or in the dark they miss the spacing and cut the film instead. A slight variation of this method, but an equally dangerous one, is to assemble a complete programme of 4,000 ft. or more on a 1,600 ft. spool, resulting in the film projecting 4 ins. or more beyond the edge of the spool. The film is taken up as in the previous case on a 1,600 ft. spool.

Yet another method of running a programme non-stop using one projector, but without large spools, is achieved by removing the top spool when there is roughly 20 ft. of film left on it, and then to unwind the film off the spool as quickly as possible, at the same time allowing the film to continue to pass through the projector. The next reel is then put on the projector and the beginning stuck by adhesive paper to the end of the outgoing reel. After

* Metro-Goldwyn-Mayer Pictures, Ltd.

the first reel has guided the second through the projector the paper is broken, and the second reel is taken up on a fresh spool. The fronts and ends of the reels have to be cut off as if they were assembled on one large spool.

The nett result of practices of this kind is a considerable cost to the renter in replacing damaged sections of film. There are, of course, several well-known makes of non-stop equipments on the market which function exceedingly well, but in my opinion a commercial exhibition should always be given with two machines.

Sound and Picture Quality

There is a large number of exhibitors who still complain about the quality of 16 mm. sound tracks. It is often found that the trouble is caused by bad setting up of the equipment.[2] So many fail to realise the importance of correct positioning of the loudspeaker and the relation of volume of sound to the size and position of the figures on the screen, if a natural illusion is to be obtained. Placing the speaker on the floor is most unsatisfactory.

The screen is another important factor and must be carefully considered if the best results are to be obtained from the print. Here again comments are made on the density of a print, whereas the screen in use is either too large or in a poor condition. The size of screen for a given hall is most important and should be carefully determined. Too many exhibitors strive for a picture far too large for the hall, with resultant loss of screen illumination. It is far better to have a smaller picture well illuminated than a large one that is underlit. For the average hall a picture 8 ft. × 6 ft. should be quite sufficient. Masking the screen and placing drapes each side improves the picture and goes a long way to impress the audience.

REFERENCES

1. *Brit. Kine.*, **12**, No. 2, Feb., 1948, p. 51 ; **15**, No. 4, Oct., 1949, p. 116.

2. *Brit. Kine.*, **12**, No. 3, Mar., 1948, pp. 81, 82, 84.

3. *Brit. Kine.*, **11**, No. 5, Nov., 1947, p. 161.

4. *Brit. Kine.*, **15**, No. 2, Aug., 1949, pp. 56, 57.

DISCUSSION

MR. H. S. HIND : Is it a bad thing to have a gate tension adjustment on a 16 mm. projector?

MR. BRADLEY : It depends on the operator and whether he is competent to adjust it. Standards will improve, but at present I think it is.

MR. F. T. JONES : What is the effect of the various makes of projectors on black-and-white film regarding heat?

MR. RAYMOND : Heat on the film plays a very important part. Film run on a well cooled projector will last much longer.

MR. N. GREEN : Does interpunching between perforations affect projection and life?

MR. BRADLEY : If it is heavy, the film will project out of focus on one side, but if the damage is only light there should be no effect on the projection or life.

MRS. WILSON : How long is a film considered to be a "green" film?

MR. GORDON CRAIG : A green film is one which still contains moisture introduced during processing and not completely removed by drying. Usually a print is regarded as green until it has been projected at least twice, by which time the heat of the projection conditions will serve to dry out residual moisture : but of course much depends on the heat generated during projection.

MR. W. HISSEY : What steps should be taken to encourage people to look after their projectors and avoid film damage?

MR. RAYMOND : In order to keep the damage to a bare minimum, it has been suggested that the K.R.S. organise periodical checks on commercial exhibitions, in order to give advice on maintaining equipment in 100 per cent. condition and to give advice on showmanship and presentation.

UNESCO PACT

Films, film-strips, micro-films and sound recordings are among the educational media upon which all customs duties, quotas and other obstacles to the exchange of such equipment have been removed by the Norwegian Government. Norway is the first country to ratify an agreement, sponsored by the United Nations Educational, Scientific and Cultural Organisation, which has been signed by fifteen other countries, and nine of these must ratify to put the agreement into effect.

THE PLACE OF FRIESE-GREENE IN THE INVENTION OF KINEMATOGRAPHY

R. Howard Cricks, F.B.K.S., F.R.P.S.

ON 10th May, 1950, occurs an interesting anniversary: the sixtieth anniversary of the acceptance of British Patent No. 10,131, in the names of William Friese-Greene and Mortimer Evans: " Improved Apparatus for Taking Photographs in Rapid Series," the application for which was made on 21st June, 1899. British kinematographers claim that this patent, and the recorded practical work of the first-named patentee, constitute him the true inventor of kinematography.

Friese-Greene (whose original name was Green) had of course many predecessors in the search for the illusion of moving pictures. In 1824, Dr. P. M. Roget read to the Royal Society a paper on certain aspects of persistence of vision, and described the rotating shutter with a narrow slit, which formed an essential feature of nearly every practical apparatus up to the date of Friese-Greene's work. In France, the work of Marey, Demény

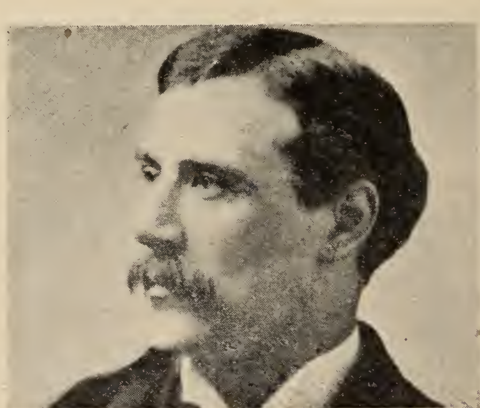


Fig. 1. William Friese-Greene.

and Reynaud is cited as forming part of the chain of invention.

The work of LePrince in this country and of Edison in the United States was practically contemporaneous with that of Friese-Greene. Subsequent to the date of the above patent a host of inventors played important parts in the development of the new science—notable among them Robert W. Paul and Birt Acres in this country, Thomas Alva Edison and C. Francis Jenkins in the United States (the latter a founder member of the Society of Motion Picture Engineers), the Lumière brothers in France, and Messter and Skladanowski in Germany.[1]

On what grounds then are we justified in asserting that this particular patent of Friese-Greene's constitutes the master patent for kinematography, and that his work entitles him, more than any other person, to be styled the inventor of kinematography?

Intermittent Motion of Film

With occasional exceptions, generally of quite limited scope, the photography and projection of motion pictures has invariably employed two major mechanical features: an intermittent movement of the film, causing it to remain stationary during the exposure or projection period, and to be rapidly moved to bring the next frame into position; and a shutter to mask this intermittent movement of the film.

The second claiming clause in Friese-Greene's patent reads:—

> In a camera, the combination of an intermittently opening shutter with means for giving an intermittent motion to a sensitised strip, the whole being actuated from a common shaft or its equivalent, in such a manner that the opening of the shutter takes place during a period of rest of the strip.

It must be agreed that unless a patent can be found in some other country ante-dating the present specification, and describing the above-named mechanical features, this clause must be accepted, if only in a purely verbal sense, as demonstrating that Friese-Greene was the originator of the principle of kinematography which has stood the test of over half a century of motion picture progress, and which shows no sign of being generally superseded.

Friese-Greene's patent had a brief and inglorious history. The inventor sold his rights, presumably to a creditor, for £500, and the new owner allowed it to lapse for failure to pay the renewal fee of £5.

Early Demonstrations

In the issue of 15th November, 1899, of the *Optical Magic Lantern Journal*

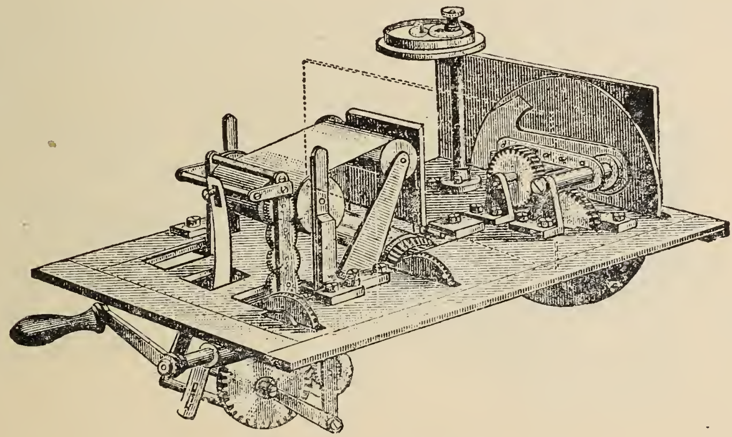


Fig. 2. The Camera of 1889 (upper view).

(which journal subsequently became the *Kinematograph Weekly*) occurs a report by the editor, J. Hay Taylor, describing in rather naïve terms a demonstration given by Friese-Green.[2] He (the editor) promised to describe the apparatus more fully in the following issue, but at Friese-Greene's request (made to comply with patent requirements) it was not until some months later that the description of the " Photoramic camera " appeared.[3] The instrument now illustrated is described as follows:—

> To outward appearance this camera is a box of about 9 ins. square; a lens protrudes from one end and a crank handle from the other. Each time the handle is turned four exposures are made on a prepared film, the film travelling along the requisite distance before the shutter is opened for exposure.

The detailed description of the apparatus makes it plain that the film was fed frictionally, by means of a drum which at each turn moved the film the space of one frame. The drum was driven by a form of Geneva movement of a permissive type, the actual movement of the drum being effected by means of a spring. A loop of film was formed between the driven paying-out drum and the intermittently rotated drum, and a second loop between the latter and the take-up.

The camera was not however also used as a projector :—

> Transparencies from negatives thus obtained are passed through two lanterns, supplied with suitable mechanism for rapidly placing them in position. By a cut-off in the rays of light the one picture is rapidly merged into another, the change taking place during the movement, when the rays of light are cut off.

Demonstrations to Royal Photographic Society

Confirmation of the fact that Friese-Greene's thoughts were already directed to the combination of film and phonograph is provided by a demonstration which he gave to the Royal Photographic Society (of whose Council he was a member) early in 1889, of motion pictures produced by means of moving glass slides. The account of the meeting contains the following words :—[4]

> He (Friese-Greene) also proposed to use a phonograph to record words spoken, and then by a series of slides taken from the sitter whilst so speaking, to be able to make the image on the screen not only move, but absolutely talk at the same time.

What is claimed to be the first public demonstration of motion pictures by means of film was held on 25th February, 1890, at a meeting sponsored by the Bath Photographic Society. The first demonstration to a London meeting, again to the Royal Photographic Society, occurred two months later,

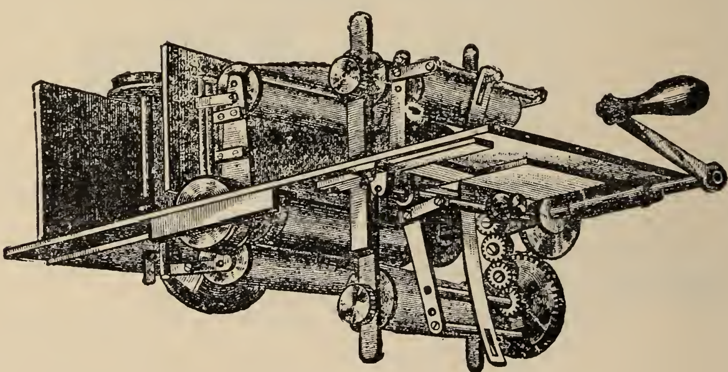


Fig. 3. The Camera of 1889 (lower view).

and is thus briefly described in the Society's journal :—[5]

> Mr. Friese-Greene said he had developed flexible films of very great length, some 20 ft., by using long dishes made of Willesden paper. He then showed another dish he had constructed to develop some very long films in ; it was made of wood, with several glass rods crossing it, and the film was kept in movement during the development. He also showed a series of 80 pictures taken very rapidly of some people walking, where the progress in movement had only been about 2 ft.

This might be read as suggesting that a number of still photographs only were displayed ; but it has been elsewhere stated[2] that the pictures in question were a film of a street scene in Brighton.

Construction of Camera

Although from his 70-odd inventions Friese-Greene was never able to earn a regular livelihood, he was undoubtedly a talented inventor. But there is no evidence that he was possessed of sound mechanical knowledge, although his co-patentee was described as a Civil Engineer. An examination of the patent, and of a camera constructed in accordance with it (now the property of Mr. S. J. Cox, and illustrated by his permission) admittedly raises the question of whether he ever succeeded in producing with it motion pictures of an acceptable standard.

As shown in Fig. 5, the camera differed considerably from that of Figs. 2 and 3. Unperforated film was fed from the take-off reel *d* to the take-up *b*, the latter of which was continuously driven. The arm *o*, carrying the roller, was actuated by the snail cam, and moved into the position indicated by dotted lines ; in its movement it pulled down the film, which then remained stationary while the roller withdrew under the influence of a spring. Simultaneously with the withdrawal of the arm, the shutter was opened by the same snail cam ; the latter was mounted upon the handle shaft, each revolution of which thus exposed a single frame of film.

American Patents Action

So much for the evidence afforded by the original patent and by the mechanical construction of the cameras. There exists another striking piece of evidence,

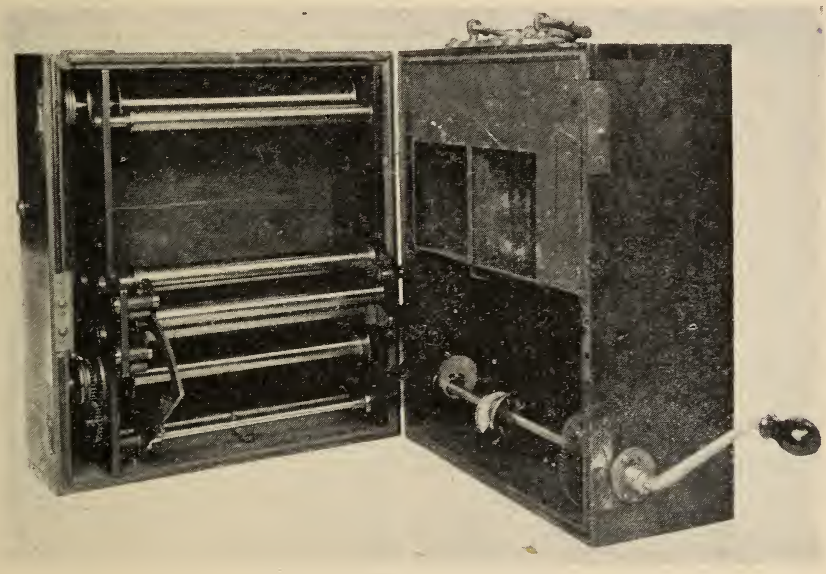


Fig. 4. The Camera of 1890.

in the form of an affidavit sworn by Friese-Greene in an action before the United States Courts.

In the year 1909 ownership of a number of United States motion picture patents was vested in a newly-formed company, the Motion Picture Patents Company. While the majority of American film exhibitors complied with demands for royalty payments, the Yankee Film Company, controlled by Carl Laemmle, opposed the claim. An action for infringement was instituted. One of the grounds of the defence was " prior invention," and to support this claim William Friese-Greene was invited to go to America.

Friese-Greene's Affidavit

In a lengthy affidavit sworn by him on 1st December, 1910 (but not entered in the Court records) is described his research work between the years 1880 and 1890. In course of this affidavit occur the following statements :—

> I devised and constructed in the latter part of 1887 and early in 1888 a camera adapted to take photographs upon a strip of sensitised paper of long length, that is, strips

about 50 ft. in length, which were wound upon two rollers, a feed roller and a take-up roller, and which strips of paper passed through a guide across the light aperture of the camera, by which the strips were intermittently exposed upon the revolution of the circular shutter, when the apertures therein registered with the light aperture of the lens. In this camera I employed a strip of paper perforated at both edges, the perforations being for the purpose of permitting registration of a pair of sprocket wheels on either edge thereof. These sprocket wheels were worked by what we then termed a star movement, to give the intermittency of motion. Turning the crank of the camera caused the star movement intermittently to engage a toothed wheel fixed to the shaft carrying the sprocket wheels, which in turn, when operated by the star movement, moved the film forward step by step across the light aperture, permitting successive portions of it of equal area to be uniformly and regularly exposed while stationary.

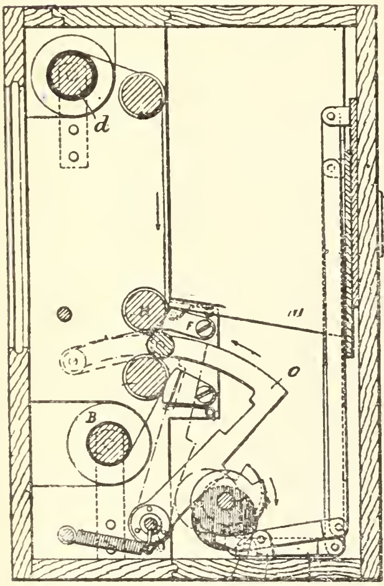


Fig. 5. Mechanism of Camera of 1890.

The Use of Celluloid

The affidavit next discusses experiments made in the production of celluloid to replace the fragile and not very transparent paper ; celluloid film was produced in 60 ft. lengths, which were spliced together. With this material, and with a new camera, the inventor was able to take pictures at the rate of 10 per second, although he realised the theoretical need for a speed of 16 frames per second.

This 1888 camera was built to take a much larger picture than the 1887 camera, and did take a negative about three inches square. This was a stereoscopic camera, taking two pictures side by side at the same time upon the same film at each exposure.

The mechanism of the camera as subsequently described appears identical with that shown in the patent. It was, however, not the design upon which the patent was actually based :—

I undertook the construction of a third camera, which was built for me by A. Lêgé & Co., Instrument Makers, of 31 and 32, Kirby Street, Hatton Garden. This camera was completed prior to 1st April, 1889. I took pictures with it for three months before I went to my patent attorney to have the application for a patent drawn. The Patent Office drawings were made from and correctly illustrate its construction, and are the originals from which were reproduced the drawings appearing in my patent Number 10,131 of 1889. . . . It was operated by me in the taking of pictures at the rate of twelve or more per second.

Correspondence with Edison

The affidavit next describes Friese-Greene's correspondence with Edison, as a result of which, a few days after the filing of the patent, details were sent to Edison. The affidavit also states :—

Among the suggested alternative constructions which I then contemplated and disclosed to Mr. Edison for accomplishing this feeding by an intermittent motion at a high rate of speed, were the use of a two-tined fork or rake caused to advance and engage the perforations in the edges of the tape-like film, which is the method of

> feeding the film which I thereafter incorporated in another camera which I subsequently constructed.

While the cameras made up to this date were constructed for wide film, a subsequent camera used narrower film—due, it has been suggested, to the availability of Eastman celluloid, which was demonstrated to the R.P.S. in February, 1890.[6]

> With this fourth camera, being actually the fifth constructed and being the second made by Lêgê, which was completed for me in May, 1890, I attained a very high speed, being able to take as many as fifty pictures per second, having reduced the size of the exposure to approximately one square inch.

Further reference to perforated film occurs later in the affidavit :—

> Towards the end of 1889, or early in 1890. . . . I manufactured film in lengths of a hundred feet. . . . The film was perforated at regular intervals by a step-by-step double punch which Légé made for me at my request, under my directions, and which perforated both edges of the film simultaneously at opposite points. He first made for me a punch for this purpose in 1887, which I used for perforating the paper strips, and this same punch I used for perforating the first celluloid film strips.

Patents Action Abandoned

A preliminary injunction was granted to the plaintiff company on 3rd June, 1911, and in the Court's decision[7] occurs the following paragraph :—

> The defence of prior invention by Friese-Greene now presented for the first time after the patent has been for several years in litigation and long since sustained by the Circuit Court of Appeals is one to be passed upon at the final hearing.

It has been stated that Friese-Greene's patent was sustained by the American Courts, but it is clear from the context that the above reference is to the patent actually at issue in the case. In point of fact the action was abandoned, and the above paragraph appears to be the only reference in the records to Friese-Greene's work. His claims were, it is clear, never considered by the Courts.

It has been suggested that Friese-Greene's affidavit was the reason for the abandonment ; while this is possible, a more probable reason was the foreboding by the plaintiff company of charges under the Anti-Trust Acts, which were indeed brought, and which three years later resulted in the Patents Company being wound up.[8]

Confirmation of Dates

Approximate substantiation of the date of the camera of 1890 is provided by a page of Légé's ledger still extant, showing the following item :—[2]

	£	s.	d.
To work on No. 2 camera from 18th April to 9th June, 183½ hours	13	15	3
Materials—Case and polishing..		10	6
Aluminium, brass		15	0

From the same source comes confirmation of the use of perforated film. No doubt the reason for the abandonment of perforations was the fragility of the oiled paper film. The extra strength of celluloid made it possible to revert to this system of traction.

In fairness to Edison, it must be added that in an affidavit pertaining to the same case as Friese-Greene's affidavit, he denied receiving the latter's first letter and drawings, and stated that in reply to a later enquiry, he informed Friese-Greene of their non-arrival. In any case, his patent of 1891[9] bears little relation to Friese-Greene's.

Accuracy of Affidavit

Surveying this affidavit after a lapse of 40 years, remembering that it related to events 20 years sooner, and regarding the pieces of equipment now illustrated, one finds it difficult to believe that Friese-Greene did not give way to optimism in some of his statements. It seems highly improbable, for instance, that the camera of Fig. 4 could ever have been operated at the rate of twelve frames per second, since, as previously mentioned, the mechanism was such that one revolution of the handle exposed one frame of film.

It is, however, apparent that an earlier camera which no longer exists actually bore a closer resemblance to modern apparatus, in employing perforated sensitive material and a " star movement," while a later camera used film more nearly approaching the present standard, and operated at a very high speed. The principle of the claw motion is also foreseen.

Subsequent History of Friese-Greene

Brief reference may usefully be made to Friese-Greene's subsequent work in the field of kinematography. He was part designer of the Prestwich camera. His principal achievement was however in the realm of additive colour films ; the writer recalls when a boy seeing him operating a camera in the studios of Cricks & Martin. In 1915, one of his patents was cited against the well-known Kinemacolor system, and resulted in the abandonment of the latter.

A considerable amount of Friese-Greene's experimental apparatus is in possession of the family of the late Will Day, pioneer film showman, thanks to whose efforts the inventor was from time to time saved from the consequence of his improvidence. In 1921, the veteran inventor attended a meeting called to discuss the low state of British film production ; after pleading emotionally for co-operation between the various sections of the trade to permit the survival of the British industry, he collapsed and died.

The Work of LePrince

There is one inventor whose work must be accepted to some extent as, if not an anticipation of, at least contemporaneous with, that of Friese-Greene. Louis Augustin LePrince in his British Patent of 1888[10] described a " receiver " (camera) and " deliverer " (projector) ; although the use of one or more lenses is claimed, its whole inception is based upon the use of a number of lenses.

At the Science Museum, South Kensington, alongside some equipment of Friese-Greene's, are two cameras in accordance with this invention, one with a single lens and another with 16 lenses. In both the film is moved intermittently by means of an intermittently rotated take-up bobbin ; the length of film moved, and the effective separation between frames, would thus vary with the increasing diameter of the bobbin. This is after all an inherent fault, since it would be impossible, for instance, to join two films or otherwise alter the length of a reel, without destroying registration.

On the other hand, a sketch of a projector constructed by LePrince shows the film driven by an intermittent sprocket, actuated by a Maltese cross ; there are no continuously running sprockets, and of course no loops of film.[11]

The work of LePrince came to an abrupt termination in 1890, when, *en route* to Dijon, he mysteriously disappeared, with his baggage which probably contained particulars of his apparatus. There is little doubt that had he lived to develop his inventions LePrince would have played an important part in the progress of kinematography, and would have shared with Friese-Greene the pioneer honours.

Claims for Edison

Although in the United States the name of Thomas Alva Edison has been often quoted as the inventor of kinematography, history proves first that most of the credit given to him should actually belong to his English assistant,

W. Kennedy Dickson. Although as early as 1888, Dickson had the idea of perforated film, fed by a Maltese cross device, his earlier work was, in accordance with Edison's ideas, confined to the production of a helix of minute images around a cylinder, adapted to be synchronised with a phonograph cylinder.[12]

It is a matter of history, too, that Edison for years favoured the peephole device, holding that to project an image was to lessen the money-making possibilities of the motion picture. His different outlook is apparent from the wording of his patent specification.

Conclusion

To summarise, it must be freely admitted that the contributions of William Friese-Greene to the practical development of kinematography are not very important. Edison, Paul, Lumière, played a far more important part in laying the technical foundations of the film industry.

It is, however, the writer's contention that Friese-Greene's work ante-dated by some years the use by any other inventor of those two essentials of modern kinematography, the intermittently moved film, its travel masked by an obturating shutter; and the perforated film.

In conclusion, the writer must express deep appreciation to Miss Ray Allister, authoress of the biography "Friese-Greene: Close-up of an Inventor," who has generously placed the relevant material—the result of years of painstaking investigation—at his disposal. The American legal records cited were kindly ascertained for her by Messrs. Reid, Cunningham & Freehill, Counsellors-at-Law, New York.

REFERENCES

1. See also "British Influence in the Technical Development of Kinematography," by the present author. *Brit. Kine.*, **11**, No. 1, July, 1947, p. 1.
2. See "Friese-Greene: Close-up of an Inventor," by Ray Allister (Marsland Publications, London).
3. *Optical Magic Lantern Journal*, **1**, No. 2, 1st Apr., 1890, p. 83. (To be seen in the library of the British Film Institute.)
4. *Phot. J.*, **13**, No. 5, Feb., 1889, p. 59.
5. *Phot. J.*, **14**, No. 8, May, 1890, p. 162.
6. *Phot. J.*, **14**, No. 5, Feb., 1890.
7. *Federal Reporter*, **183**, p. 989; **187**, p. 1007; **192**, p. 134.
8. *Federal Reporter*, **225**, p. 800.
9. *U.S. Pat.* 589168.
10. *Brit. Pat.* 423, 1888; *U.S. Pat.* 376247, 1888.
11. *Phot. J.*, **63**, No. 8, Aug., 1923, p. 373; *J. Soc. Mot. Pic. Eng.*, **17**, No. 1, July, 1931, p. 46.
12. *J. Soc. Mot. Pic. Eng.*, **21**, No. 6, Dec., 1933, p. 435.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

NEW TRACKING AND LIGHTING TECHNIQUE

The opening sequence of a French film, "La Ronde," consists of a 600 ft. non-stop tracking shot, during which the camera travelled over 200 ft. of rails, while the lighting changed from day to night. *Tech. Ciné.*, April, 1950.

INFLUENCE OF TEMPERATURE ON COLOUR SENSITIVITY OF EMULSIONS

Appreciable changes in the colour sensitivity of photographic emulsions are found at very low temperatures, such as −195°C.

J. Opt. Soc. of America, abstracted in *Sci. et Ind. Phot.*, April, 1950.

YUGOSLAVIA HIGHER FILM SCHOOL

The Higher Film School in Belgrade has set itself the task of providing Yugoslavia's young film industry with new workers. In the course of 1948, 43 students started working after graduating from the school.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library.

DEMINERALIZATION OF PHOTOGRAPHIC WASH WATER BY ION EXCHANGE

H. P. Gregor and N. N. Sherman, *J. Soc. Mot. Pic. Eng.*, August, 1949, p. 183.

An ion exchange system has been developed to purify photographic wash water and allow its re-use. The effluent from a print-washing machine is cycled through a cation and then an anion exchange resin bed, and returned to the machine. The purity of the water obtained approaches that of distilled water. AUTHORS' ABSTRACT.

LABORATORY FOR DEVELOPMENT WORK ON COLOUR MOTION PICTURES

H. C. Harsh and K. Schadlich, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 50.

Precise control of all of the laboratory operations in producing colour motion pictures is essential to obtain release prints of high quality. A description is given of a new building and equipment especially designed to carry on development work on all the laboratory phases of producing motion pictures in Ansco Color. AUTHORS' ABSTRACT.

USE OF 35 mm. ANSCO COLOR FILM FOR 16 mm. COLOUR RELEASE PRINTS

R. H. Ray, *J. Soc. Mot. Pic. Eng.*, August, 1949, p. 143.

A survey of the photographing of commercial films in 35 mm. Ansco Color for release in 35 mm. Ansco Color and 16 mm. Kodachrome. R. H. C.

FILM VAULTS: CONSTRUCTION AND USE

J. G. Bradley, *J. Soc. Mot. Pic. Eng.*, August, 1949, p. 193.

American regulations permit the storage of 10,000 lbs. of nitrate film in a single vault, cans being packed vertically. An improved type of vault is described employing horizontal storage, while for films of special value a storage cabinet is preferred. Methods of fire protection of individual reels, and of sprinkler installation, are discussed. R. H. C.

INSPECTION OF FINE PITCH GEARS

G. Smithson, *Standardisation*, August, 1949, p. 207

Errors in gears are grouped as tooth errors, run-out (*i.e.* eccentricity), size errors, and surface finish. Methods of computing tolerances in the first three are set out in American standards. Surface finish is omitted from the discussion. R. H. C.

AUTOMATIC BRAKING DEVICE FOR X-RAY APPARATUS

J. M. Constable, *Philips Tech. Rev.*, August, 1949, p. 50.

A magnetic braking device, operated by a magnetic drag, causes a servo-motor to come to rest within two or three revolutions. The system has also been applied to machine-tools. R. H. C.

1,000-FOOT BIPACK MAGAZINE AND ADAPTOR

W. R. Holm and J. W. Kaylor, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 58.

A bipack camera magazine carries the two rolls of film side by side. R. H. C.

MAGNETIC RECORDING IN THE MOTION PICTURE STUDIO

W. A. Mueller and G. R. Groves, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 605.

The paper deals with the large variety of applications of both magnetic tape equipment and synchronous magnetic film recorders. Tape has been most useful for training purposes, talent testing and coaching, playbacks, re-recordings, foreign versions, publicity recordings, etc.

Synchronous magnetic film has proved to be a time, film and money saver. The current cost of magnetic film is about £6 per 1,000 feet cheaper than the same length of processed sound track negative plus print therefrom. The authors visualise that magnetic recording will eventually replace the photographic method entirely. O. K. K.

PORTABLE MAGNETIC RECORDING SYSTEM

O. B. Gunby, *J. Soc. Mot. Pic. Eng.*, July, 1949, p. 613.

Studio experience with synchronous magnetic film recording has led to detailed specifications of the equipment. It is suggested to design the new apparatus for both photographic and magnetic recording alternatively. Features for a portable recording system are indicated and a light RCA camera has been modified correspondingly. O. K. K.

DUPLICATING TAPE RECORDINGS

Reynolds Marchant, *Electronics*, July, 1949, p. 72.

An experimental duplicating machine for magnetic recordings on narrow tapes is described Eight re-recordings can be made from one master simultaneously, the recordings being of the twin-track type. One of the two tracks is re-recorded backwards, the other forwards; duplicates can thus be used without further re-winding. The economic aspects appear to be satisfactory. O. K. K.

TELEVISION PICK-UP FOR TRANSPARENCIES

R. D. Thompson, *J. Soc. Mot. Pic. Eng.*, Aug., 1949, p. 137.

Equipment restricted to pick-up of transparencies can be of simple and reliable design. A motor-driven slide-changing mechanism accommodating as many as 25 2 by 2 in. glass slides is described. Aesthetic transitions possible include automatic picture fading and instantaneous change-over. AUTHOR'S ABSTRACT.

THE COUNCIL

Meeting of 5th April, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), E. Oram (*Deputy Vice-President*), Rex B. Hartley (*Hon. Secretary*), M. F. Cooper, H. S. Hind, B. Honri, R. E. Pulman, I. D. Wratten, R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

A. G. D. West Memorial.—It was agreed that the donation of £25 for a memorial to the late Captain West should be expended on a suitable Presidential insignia.

Mr. Voigt.—At the farewell luncheon arranged for Mr. and Mrs. Voigt, the President had, on behalf of the Council, wished them good health and a successful future.

Accounts.—The draft Balance Sheet and Income and Expenditure Account for the year ended 31st December, 1949, was presented and approved with one minor exception.

Elections.—The President reported the nominations for Officers, Council, Divisional Representatives on Council, and Divisional Committees.

Hon. Treasurer.—Attention was drawn to the resignation of Mr. Bastie, and the Presiden remarked that he would be sadly missed.

Sub-Standard Film Division.—In view of the election of Mr. Hind as Hon. Treasurer, Mr. Leevers was appointed Chairman of the Sub-Standard Film Division.

Special Executive Committee.—The President reported on a Special Executive Committee meeting at which staff matters were discussed.

Education Committee.—Mr. Wratten reported on the meeting which had taken place on 8th March, 1950.

Film Production Division.—Mr. Honri reported on a meeting of the Film Production Division Committee on 15th March. Proposals for papers for the 1950/51 Session had been considered. It was requested that there should be five joint meetings with the A.C.T. and four divisional meetings.

Papers Committee.—The Vice-President reported a meeting of the Papers Committee on 22nd March, when the lecture programme for the 1950/51 session had been considered.

Branches Committee.—The position regarding the Leeds and Manchester Sections was briefly considered.

Social Committee.—Mr. Oram reported on decisions reached concerning future social activities.

American Distribution of Journal.—Mr. Cricks's proposals for distributing copies of the Journal in America were approved.

EXECUTIVE COMMITTEE

Meeting of 14th April, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), E. Oram (*Deputy Vice-President*), Rex B. Hartley (*Hon. Secretary*), I. D. Wratten (*co-opted*) Miss J. Poynton (*Secretary*) and Miss S. M. Barlow (*Assistant Secretary*).

Elections.—The following were elected :—

Albert William Oakes (Member), Chiltern Films, Berkhampsted.
Nathaniel Mole (Member), Associated British Cinemas, Ltd.
Wallis Williams (Associate), Theatre Royal, Barry.
E. Mitchell Greenwood (Member).
Frederick Clarence Rich (Associate), Greater Union Theatre Pty. Ltd., Sydney, Australia.
Raymond Liddell (Member), Simpro Ltd., Minehead.
Benjamin Hall Hipkins (Member), Malayan Film Unit.

Transfer.—From Studentship to Associate :—

John Eric Shepard White.

Resignations.—The following resignations were accepted with regret :—

Edward James Lewis.
Kenneth Alfred White.

Death.—The death of Frederick Lawrence Furey was recorded with regret.

COMMITTEE MEETINGS

Education Committee—8th Mar., 1950

The provision of further education in studios was discussed. Mr. Honri agreed to ascertain whether a course of lectures on Lighting would find support. Difficulty was being found in arranging suitable accommodation for the course of lectures on Sensitometry. The position regarding employment of overseas students was reported upon.

Film Production Division Committee—15th March, 1950

Arrangements for the annual Studio visit were agreed upon. Suggestions for papers to be delivered in the 1950-51 session were agreed for submission to the Papers Committee. The question of joint meetings with the A.C.T. was discussed.

Foreign Relations Committee—17th March, 1950

Approaches were being made to other countries to seek information concerning kinematograph societies.

Papers Committee—22nd March, 1950

Society Meetings for the coming session were discussed. Proposals from the three Divisions were considered.

Library Committee—3rd April, 1950

The proposal that the Council be asked for an allocation of £25 was agreed. The system of classification was further considered.

TELEVISION IN SOUTH AFRICA

At a Johannesburg exhibition this month, large-screen television will be demonstrated by Marconi and Cinema-Television Ltd. From a studio and an outside unit, pictures will be transmitted to a number of home receivers, and also to a specially adapted hall in which 500 people will be able to watch the picture.

PERSONAL NEWS of MEMBERS

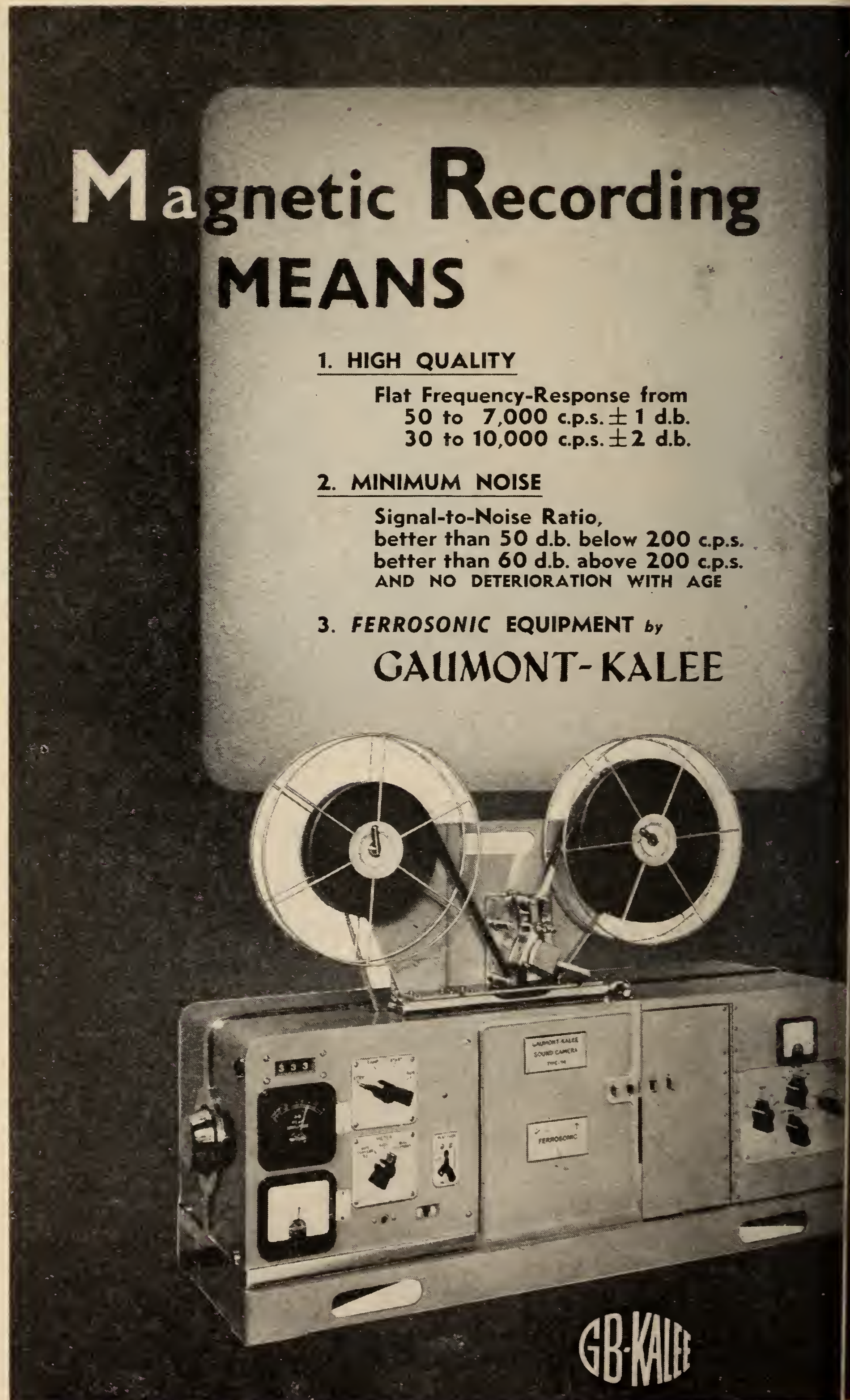
C. R. GIBBS, formerly Technical Officer of the B.F.I., has now joined the staff of Mole Richardson (England) Ltd.

M. A. RAYLAN, who is leaving for Istanbul, has expressed his thanks for the help he has received whilst in this country, especially the Members of this Society.

E. ORAM is now on a visit to Canada.

SITUATION VACANT

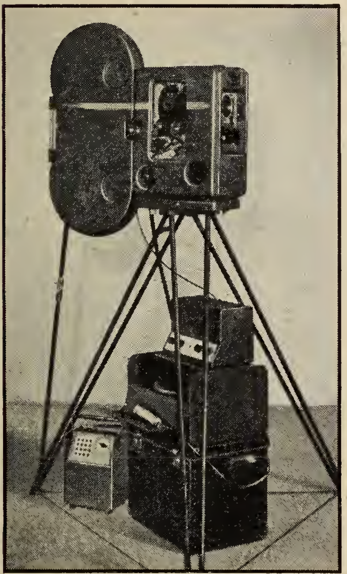
Dunlop Rubber Company requires lady Assistant Cinematographer, 22 or over, for Technical Photographic Department. Duties would include preparation of film shooting scripts, editing of 16 mm. films, preparation of title layouts, 16 mm. camera operating, ordering of films and their projection. Applicant must have I.B.F. Inter. and Inter. B.Sc., or H.S.C., and have taken two years course in Photography and Kinematography at the Regent Street Polytechnic. Experience is required in the following fields: Still and 16 mm. Sub-standard kinematography in monochrome and colour, 16/35 mm. sound film projection, recording and organisation of outside services. Apply, giving details of age, qualifications and experience, to: PERSONNEL MANAGER, Dunlop Rubber Co. Ltd., Erdington, Birmingham, 24.



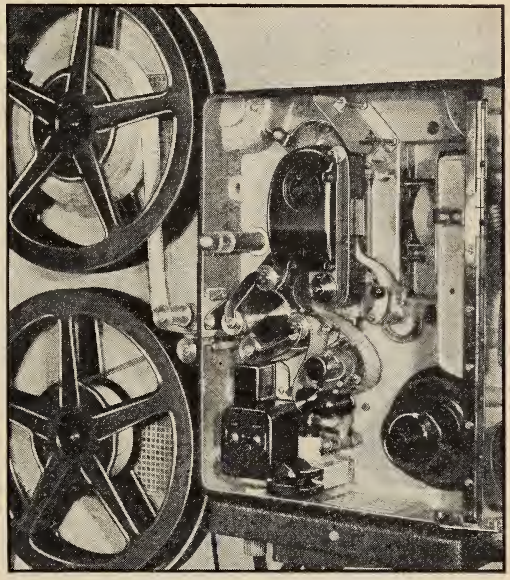
Magnetic Recording
MEANS
1. HIGH QUALITY
Flat Frequency-Response from
50 to 7,000 c.p.s. ± 1 d.b.
30 to 10,000 c.p.s. ± 2 d.b.
2. MINIMUM NOISE
Signal-to-Noise Ratio,
better than 50 d.b. below 200 c.p.s.
better than 60 d.b. above 200 c.p.s.
AND NO DETERIORATION WITH AGE
3. FERROSONIC EQUIPMENT by
GAUMONT-KALEE
GB-KALEE

NEW PORTABLE 35mm. Sound Film Equipment

Combines many extra safety features



Should the film catch fire in the gate, the twin spool-box fire-trap automatically shuts. A ventilating rear shutter minimizes heat on the film.



Neither the projection lamp nor the rear motor can operate if :— The projector doors are open ; the film speed drops below 20 pic/sec ; the automatic film-rupture device comes into operation ; the belts have not been put on.

Brilliant Picture of Large Dimensions : 1,000-watt projection lamp with concentrated filament. Optical system and surface-coated projection lens of very large aperture. Rear shutter with high-light efficiency.

True-To-Life Sound Reproduction : Sound-head with rotating sound drum. 20-watt amplifier. Ideal loudspeaker combination.

Easily Portable: The heaviest part, the projector mechanism with sound head, weighs only 67 lbs. (30.5 kg).

Erected in a few minutes : The projector is fixed to the adjustable stand with two large milled screws. The twin spool-box can be fixed up in one easy manipulation.

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(A169B)

BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

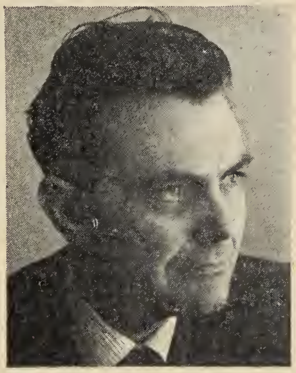
VOLUME SIXTEEN, No. 6 JUNE, 1950

B.K.S. CONVENTION

The first Convention of the British Kinematograph Society was held on Saturday, 29th April, 1950, at the Gaumont-British Theatres, Wardour Street, London, W.1.

The proceedings opened with the annual general meetings of the three Divisions, followed by the Ordinary Meeting of the Society. The elections showed that two new members joined the Council, Messrs. Norman Leevers and S. A. Stevens.

FREDERICK NORMAN GEORGE LEEVERS, B.Sc., A.C.G.I. (*Fellow*)



SIDNEY ARTHUR STEVENS, B.Sc., M.I.E.E., D.I.C., A.C.G.I. (*Member*)

In course of the Presidential Address which followed, the President unveiled an oil painting of the late Capt. A. G. D. West, presented by two anonymous donors. Announcements of the award of the Hon. Fellowship and Fellowship were made (see last month's issue), and a presentation was made to Mr. Percy H. Bastie in recognition of his many years' service to the Society. Medals were also presented in respect of technical contributions to the lecture programme. The above meetings are reported in this issue.

Following the Presidential Address, a paper entitled "The Application of Science to the Motion Picture Industry" was presented by Sir Robert Watson-Watt, C.B., F.R.S., D.Sc., scientific adviser to the J. Arthur Rank Organisation. This will be reported in a later issue.

PRESIDENTIAL ADDRESS

A. W. Watkins, A.M.I.E.E., F.B.K.S., F.R.P.S.

Presented to the British Kinematograph Society on 29th April, 1950

AT this the first Convention of the British Kinematograph Society we sadly miss the presence of one who attended every previous annual meeting of the Society. On 22nd August last year, the Society sustained an irreparable loss in the death of Capt. A. G. D. West.

He was indeed a pillar of the Society. He devoted so much time and mental energy to the Society's affairs.

Two anonymous donors felt that the least that could be done was to present a portrait in oils and I now propose unveiling this portrait.

Capt. Will Barker has presented a cheque as a memorial to Capt. West. The Council has decided that, in view of Capt. West's particular interest in the Society as President, it would be appropriate to purchase a Presidential Insignia, in the form of a medallion of office. The design of the medallion is in hand.

The President unveiling a portrait of the late Capt. A. G. D. West, M.A., B.Sc., F.R.P.S. (Hon. Fellow) painted by Mr. Peter Ellenshaw, and presented to the Society by two anonymous donors

The Fellowship Committee has nominated, and Council has approved, the election of three new Honorary Fellows, in recognition of their great contributions to the British motion picture industry. They are Sir Michael Balcon, Sir Alexander Korda, and Mr. J. Arthur Rank.[1]

For their technical contributions the Council has approved the award of the Fellowship to Messrs. H. S. Hind, Baynham Honri, Dr. O. K. Kolb, Mr. A. Warmisham, and Dr. G. I. P. Levenson.[1]

An anonymous donor has presented medals for award in respect of the most outstanding paper delivered during each President's term of office. During Mr. Wratten's presidency, from 1946 to 1948, it had been decided that the best paper was that read by Dr. Levenson, on " Controlling the Elon-hydroquinone Developer."[2] During Mr. Harcourt's presidency, from 1948 to 1949, Mr. Warmisham's paper " Transmission Calibration of Photographic Lenses "[3] had been selected.

For many years we have had the co-operation of Mr. Percy H. Bastie. In recognition of his thirteen years as Hon. Treasurer, the Council decided to make a small presentation, and I now have pleasure in presenting to him a pen and pencil set.

The previous arrangement of the annual general meetings of the Divisions and of the Society, also the Presidential Address, taking place on different occasions, did not seem in keeping with the dignity of the Society. The Council therefore decided that the events should be held on the one day, in the form of a Convention. The large attendance at to-day's meetings has fully justified that decision. It has been decided that the Convention shall in future be held on the first Saturday in May. It was held a week earlier this year in order to avoid its occurring a week before the visit organised by the Film Production Division to Ealing Studios.

There had been a suggestion that we might have an informal dinner following the Convention, but the Social Committee reluctantly decided against such an arrangement. It is, however, hoped henceforth to hold a formal dinner annually ; arrangements are in hand for the first such event, towards the end of the year.


Medal awarded for Outstanding Papers

The Society exists for the purpose of helping to raise the technical standard of education in the industry. The Council feels it has lost a great opportunity in not having used the money which we shall have to pay in income tax in instituting a scheme of education. It is the intention of Council to proceed as soon as possible with further educational plans ; whether it be full-time day lectures or evening lectures or both has not been finalised.

In our new premises we can for the first time say we have headquarters which are much more in keeping with the dignity of the Society.

Mr. Oram's work as Hon. Secretary was one of the most outstanding features of the Society. He, together with Messrs. West, Bastie and Cricks, were the four major people who have kept the Society alive. It was with great regret that we found Mr. Oram wished to resign from the Hon. Secretaryship, due to pressure of business. Fortunately, we have been able to persuade him to continue as a member of Council, to which he has been elected. We on Council, in appreciation of his hard work, made him a presentation of a case of pipes.

I will close my brief Presidential Address with an extract from the last Presidential Address of Capt. A. G. D. West :—[4]

> My recent experiences in discussing the future of the B.K.S. with the commercial leaders of the Industry demonstrate that the Society is surely finding for itself a definite and authoritative place in the Industry, where members can freely discuss technical problems on common ground to the advantage of all concerned, and where the encouragement of standards of technical efficiency, both as regards personnel and equipment, can be not only maintained, but continually improved. The increasing support given by Patron Members confirms that in these respects the Society is travelling on the right lines. May it continue to progress and hold the confidence of the Industry it serves.

REFERENCES

1. *Brit. Kine.*, **16**, No. 5, May., 1950, p. 141.
2. *Brit. Kine.*, **12**, No. 2, Feb., 1948, p. 37.
3. *Brit. Kine.*, **14**, No. 4, April, 1949, p. 101.
4. *J. Brit. Kine. Soc.*, **9**, No. 1, Jan., 1946, p. 2.

THEATRE DIVISION

THE B.K.S. Convention, held on 29th April, 1950, opened with the Annual General Meeting of the Theatre Division. The Chairman, Mr. S. B. Swingler presided, and submitted the following report.

Chairman's Report

Membership.—Membership now totals 417, which is a loss of 22, but your Committee feels that during the next year we should be able to embark on a membership drive which, it is hoped, will result in a considerable increase.

Chairman.—You will be aware that Mr. S. A. Stevens will be succeeding me as Chairman of the Theatre Division. I am very happy to welcome him on your behalf, and to offer him my fullest support.

Meetings and Demonstrations.—Your Committee has followed the policy adopted by the Papers Sub-Committee in regard to demonstrations of modern equipment. It is hoped to afford you the opportunity of seeing a demonstration of large screen television during the next session.

Activities.—Members of the Division have been very active on the Committees of the British Standards Institution, dealing with problems concerning theatre design and equipment. I have recently represented your Division on the National Illumination Committee on Kinema Lighting.

Conclusion.—I once again ask members of the Theatre Division to keep their Committee members fully aware of the subjects that they would like presented or discussed at meetings, and of any directions in which your Committee can further their interests.

Once again it gives me pleasure to express our appreciation of the assistance given by Mr. Abbott and his staff during the past year, and to thank Messrs. Gaumont-British Picture Corporation Ltd., for the continued use of their private theatre.

President's Thanks

The President congratulated the retiring Chairman and his committee on the work that had been done during the last twelve months.

In course of a discussion on the Division's activities, Mr. R. H. Cricks urged that co-ordination should be instituted with the Kinema Projectionists' and Engineers' Association.

SUB-STANDARD FILM DIVISION

AT the Annual General Meeting of the Sub-Standard Film Division, the Chairman, Mr. H. S. Hind, presided, and submitted a report, of which the following is an abridgement.

Chairman's Report

Membership.—The current membership of the Division is 272, showing a net increase of 13.

Lecture Papers.—During the past session the attendance at all meetings has been very good. Your Committee is anxious that new Members attending meetings should not feel out of things, and to avoid this three stewards are on duty at each meeting. Your Committee has finalised all the major details of next session's programme.

Improvements in 16 mm. Prints.—Your Committee has under consideration means whereby the Society may assist in effecting improvements in the presentation of 16 mm. films. It would seem that the problems extend through all stages, from production to projection.

Conclusion.—Finally, I would like to express my personal appreciation and thanks to all Members of the Division Committee.

Election of Officers

The Chairman then announced the result of the elections to the Committee (see page 184).

President's Comments

The President added his personal thanks to Mr. H. S. Hind for his valuable contribution to the well-being of the Society as a whole. In referring to Mr. Hind's election to the office of Hon. Treasurer the President stated that the Division's loss was the Society's gain, because there was no other member whom the Council could envisage as a Treasurer more fitted for the office.

Vote of Thanks

Mr. Raymond proposed a vote of thanks on behalf of the general body of members to the Committee and its Chairman, which was duly accorded.

FILM PRODUCTION DIVISION

MR. B. HONRI took the chair at the Annual General Meeting of the Film Production Division. His report was as follows.

Chairman's Report

Membership.—Considering the low ebb to which the British film production has momentarily fallen, it is with very considerable satisfaction that I am able to announce that we have increased our membership. The figures are as follows: Corporate Members 313, Associates 167, and Students 40, making a total of 520—an increase of 50 over last year.

Divisional Secretary.—I would particularly like to pay a tribute here to the efforts of our Divisional Hon. Secretary, Mr. Rex B. Hartley, who has enrolled so many new members and has maintained such excellent contact with studio members.

Lectures.—In choosing subjects and inviting lecturers to speak, the task has not always been easy. Advanced subjects, which some members prefer, and which do, in fact, make the biggest contribution to the progress of our industry, do not always attract the largest audiences; on the other hand, they provide the Editor of our journal BRITISH KINEMATOGRAPHY with his best material.

Relations with other Societies and Associations.—We have maintained friendly relations with other Societies and Associations. I would particularly like to refer to the co-operation we have had from the A.C.T., which resulted in five very successful joint meetings.

Vote of Thanks.—I would like to express my thanks to all members of the Committee for their support and co-operation with me during my term of office.

Participation in Television Matters

Mr. T. S. Lyndon-Haynes asked that consideration be given to the extension of the Division's activities to cover television. Mr. N. Leevers thought the question of television came no more within the scope of the Film Production Division than of the Sub-Standard Film Division.

President's Thanks

The President congratulated the Chairman of the Division. The Council was very grateful to him and to the Division as a whole for the enormous amount of work it had carried out on behalf of the Society. He expressed his hope that when the industry recovered, as it surely would, the Division would go on from strength to strength.

ORDINARY MEETING

THE fourth Ordinary Meeting of the British Kinematograph Society was held on 29th April, 1950. The President, Mr. A. W. Watkins, was in the chair.

Minutes

The minutes of the Ordinary Meeting of May 25, 1949, were read by the Hon. Secretary, Mr. Rex B. Hartley, and were agreed.

Hon. Secretary's Report

The Hon. Secretary submitted his report as follows:—

To-day I meet you all for the first time as Honorary Secretary of the Society. The preparation of this report has been no easy task for me to undertake, as for so many years it has been so capably presented by our former Hon. Secretary, Mr. Edwin Oram, now our Deputy Vice-President. Mr. Oram has seen the Society grow from very small beginnings; in fact, he has been a guiding force in its present success.

Premises.—As members will recollect, our lease came to an end in Dean Street, and it was with the greatest difficulty that temporary premises were found at New Oxford Street, where we remained until early this year. We are not forgetful of the kindness extended to us by our former hosts, Merlin Films Ltd., and Technical & Scientific Films Ltd. We now have our offices at 117, Piccadilly, W.1, where accommodation, commensurate with the status of a technical society, is occupied. The offices in this Carnegie Trust building were made available to us through the British Film Academy and the Bureau of Current Affairs.

Membership.—Notwithstanding the difficult year for the motion picture industry, and although there was an increase in subscription at the beginning of the year under consideration, I am happy to inform you that there has been a net gain in membership of 72. The figures are as follows :—

	1949	1950
Hon. Fellows, Fellows, and Hon. Members	31	38
Corporate Members ...	589	643
Associates	379	407
Students	86	69
	1,085	1,157

Patron Membership.—A list of Patron Members appears in each issue of British Kinematography, and we owe a great debt of gratitude to them for the financial support which they give us annually. Although representative of the motion picture industry the list excludes many important firms, and I do look to members to co-operate in adding to the number.

Joint Meetings.—As with most other Societies, attendance at meetings showed signs of reduction. The Papers Committee, under the able Chairmanship of Mr. Leslie Knopp, appears to have chosen a very suitable level for meetings to attract larger audiences. Increased attention is also due to the meetings arranged jointly with other organisations, whose members have been very welcome. These are : the Royal Photographic Society ; the Television Society ; the Scientific Film Association ; the Association of Cinematograph and Allied Technicians ; the British Sound Recording Association ; and the Institution of Engineering Inspection.

In addition, meetings of the Theatre Division and the Sub-Standard Film Division have taken place, and the Film Production Division was responsible for arranging the joint meetings with the A.C.T. During the year we included a visit to the studios of the Associated British Picture Corporation at Elstree, where we received a particularly warm welcome.

Journal.—Although many Societies are experiencing financial difficulties in the publication of their journals, we have still carried on publishing British Kinematography monthly. Rightly or wrongly, I maintain that the interests of members are best served by receiving this Journal every month. Papers have been reported with less delay from the time of their presentation, and members are now kept *au courant* with the meetings of the committees.

Education.—It is much to be regretted that the course in kinematography, which for 16 years had been organised at the Regent Street Polytechnic in conjunction with the Society, has had to be discontinued ; also that the specialised evening courses have had to be terminated owing to the other commitments of the lecturer, Mr. Malcolm Hoare, to whom the highest appreciation should be expressed for his valuable work. Arrangements are in hand which, it is hoped, will permit of the latter course being recommenced in the Autumn.

Divisions.—I need do no more than refer briefly to the work of the Divisions, as their respective Chairmen have submitted their individual reports, but I would like to emphasise the important part their activities play in the functions of the Society.

Sections.—A decision of Council that provincial meetings should be restricted to five per session in each territory has delayed progress in the three provincial sections. The matter is to be reconsidered for the forthcoming session.

The Leeds Section sustained a great loss through the death of its Hon. Secretary, Mr. F. L. Furey, M.B.K.S., who had done a great amount of work in the Section. Mr. L. J. Mannix, Chairman of the Leeds Section, is carrying on his duties.

Standardisation.—In the preparation of standards specifications, members have played an important part in the deliberations of the British Standards Institution. A number of specifications have been published in the last year which had their genesis in meetings of the technical committees of the Society.

Library.—The Library continues to increase its size, and now contains some hundreds of books, in addition to many bound volumes of technical journals—probably the most complete selection of books on the technical aspects of kinematography of any library in the country. I would like to express the Society's appreciation and thanks to those members of its Library Committee, and its associate helpers, who have devoted so much of their spare time to arranging it.

Arrangements have now been concluded whereby provincial Sections of the Society may borrow books, requested by their members, in bulk. The Library Committee is at work, among other things, on preparing a new classification system for works on kinematography.

Finances.—The report of the financial affairs of the Society I will leave in the capable hands of the Hon. Treasurer, our worthy Hon. Fellow, Mr. P. H. Bastie. For many years he has safeguarded the Society's interests, enforcing stringent economies wherever possible, but at no time stinting his own efforts on our behalf.

Staff.—January, 1950, saw the transfer of the Secretaryship from Mr. W. L. Bevir to Miss Joan Poynton. Miss S. M. Barlow, known to many of you in her work as Assistant Secretary, overcomes many obstacles in maintaining advertising revenue for the Journal.

I would like to take the opportunity of expressing my sincere gratitude to our most competent and highly qualified Technical Consultant and Editor, Mr. R. Howard Cricks, who for so many years has been connected with the Society.

Overseas Relations.—Through our Member, Mr. Eric Williams, of Ealing

Studios, Sydney, new members have been enrolled. The Society has been able to assist our Indian representative, Mr. Y. A. Fazalbhoy.

The Society has been in regular contact with the Society of Motion Picture and Television Engineers, and with the technical societies of many other countries, including France, Germany, Italy, Bulgaria and Czechoslovakia.

We shall use every endeavour, through this committee, to extend our contacts in other countries.

Conclusion.—Much of the success of the future of the Society rests upon three words —enthusiasm, energy and initiative—and it is you, the members of the Society, who must make these words a reality.

Hon. Treasurer's Report

In submitting the annual accounts, Mr. P. H. Bastie made the following report.

This is the thirteenth year that I have had the honour of submitting the annual accounts of the Society, and I am pleased to say that on this my last occasion as your Hon. Treasurer, the accounts, for year ended 31st December, 1949, show that the Society is in a better financial position than was the case two years ago. However, this does not mean that there is any room for complacency, particularly in view of the difficult times through which we are passing and which undoubtedly lie ahead of us.

Income.—With regard to income, the subscriptions have increased to £2,284, as compared with £1,848 in the previous year. Entrance fees have decreased to £176, as compared with £290, which shows that the volume of new members has not been so great, and Patron Members' donations have also decreased to £998 as compared with £1,065. These and other items bring our total income to £3,534, as compared with £3,294 in the previous year.

Expenditure.—On the expenditure side, a considerable saving has been effected in the cost of meetings and educational work, but unhappily this is more than offset by a rather large income tax reserve.

The deficit of £142 on the publication of the Journal is increased, and this despite the most stringent efforts to cut production costs. It is hoped that the change of printers, which has taken place, may bring about a reduction in cost, which will be reflected in next year's accounts. An increase in income over expenditure for the year of £387, as compared with £218 in the previous year, is satisfactory and there is a total expenditure of £3,534, as compared with £3,294 in 1948.

Bank Balance.—The balance at the bank of £293 is fairly satisfactory. I think you might even call it very satisfactory when you consider the difficult times, and the fact that this figure has increased by £90 since 1948.

Adoption of Reports

Mr. H. S. Hind proposed, and Mr. F. G. Gunn seconded the adoption of the reports of the Hon. Secretary and Hon. Treasurer. This was carried unanimously.

Election of Officers and Council

The President announced that the following officers had been elected unopposed :—

President : Mr. A. W. Watkins. *Hon. Secretary :* Mr. Rex B. Hartley.

Vice-President : Mr. L. Knopp. *Hon. Treasurer :* Mr. H. S. Hind.

The following had been appointed as scrutineers in the election for members of Council : Messrs. B. Druce, D. Forrester, G. Portch, and A. C. Snowden. Their report showed the following to have been elected : Messrs. F. G. Gunn, E. Oram, and N. Leevers.

Divisional Representatives

The President reported that Mr. T. W. Howard had been re-elected Council representative of the Film Production Division, and that Mr. S. A. Stevens and Mr. F. N. G. Leevers had been returned unopposed as representatives of the Theatre Division and the Sub-Standard Film Division respectively.

The President pointed out that as Mr. Leevers had been elected as an ordinary member of Council, the Sub-Standard Film Division would be given the opportunity of holding a further election for their representative on Council.

Appointment of Auditor

The President stated that Mr. Johnson had resigned from the position of Auditor. The Finance Committee recommended that Messrs. Finnie, Ross, Welch & Company be appointed. It was proposed by Mr. B. Honri, and seconded by Mr. F. G. Gunn, that this company should be appointed auditors. This motion was carried.

President's Address

Mr. A. W. Watkins said that he would like to express his own thanks, in addition to those put forward by the Hon. Secretary, to the staff, which really worked hard in the interests of the Society. At 117, Piccadilly, every member was received in the most pleasant way, and all the advice and assistance which the office could offer was at their disposal.

The Society had been fortunate in finding Miss Poynton to take over its affairs. It was immediately after her appointment that they moved into the new offices. It had been a very difficult time for her, but she was " right on the top of the job," she was doing exactly what was wanted from the Secretary of the Society, and to her and Miss Barlow and to Mr. R. Howard Cricks, our technical consultant and editor, sincere thanks and admiration were expressed.

Other Business

Mr. T. S. Lyndon-Haynes asked that the membership of committees should be spread over larger number of members, and to assist this, made a proposal that the possibility of enlarging Council by four members should be considered next year. Subject to an amendment by Mr. H. S. Hind that two of the additional members of Council should be Associates, the proposal was carried, the President pointing out that it required merely that the matter should be discussed.

Referring to the discussion on the place of television in the Society (Film Production Division Meeting, p. 181) the President said the matter had been considered by Council, and the friendly relations with the Television Society would be considered in any action taken on this matter.

Votes of Thanks

The President said that it was his very pleasant duty to propose a vote of thanks to the Gaumont-British Picture Corporation and to Mr. J. S. Abbott, Hon. M.B.K.S. and his staff for the use of the theatres ; to the Merton Park Studios, coupled with the name of Mr. H. S. Hind, for the use of a committee room ; and to the Cinematograph Exhibitors' Association, coupled with the name of Mr. Leslie Knopp, for the use of the Council room. Also included in the vote of thanks were the advertisers in British Kinematography, all who had served on the Council and its committees, and finally the trade papers for reporting the meetings of the Society. This resolution was carried unanimously.

DIVISIONAL COMMITTEES

The composition of the Divisional Committees for the current year, as completed by the recent elections, is :—

		Appointed by Council until 1951	Appointed by Council until 1952	Elected until 1951	Elected until 1952
THEATRE DIVISION	S. A. Stevens *Chairman and Council Representative*	A. E. Ellis W. F. Garling S. T. Perry	L. A. Blay R. Pulman S. B. Swingler	F. H. Sheridan-Shaw H. C. Stringer J. A. Walters	C. H. Bell W. V. De'Wan H. Lambert
SUB-STANDARD FILM DIVISION	N. Leevers, *Chairman* D. F. Cantlay *Council Representative*	M. V. Hoare G. H. Sewell	W. Buckstone H. S. Hind	H. E. Dance J. Masterton	D. F. Cantlay D. Ward
FILM PRODUCTION DIVISION	B. Honri *Chairman* T. W. Howard *Council Representative*	F. G. Gunn H. Harris T. W. Howard	C. E. W. Crowhurst W. M. Harcourt Rex B. Hartley	F. J. G. Cox H. Waxman F. Young	W. S. Bland G. E. Burgess T. S. Lyndon-Haynes

AFITEC ELECTS NEW PRESIDENT

At the Annual General Meeting of the Association Française des Ingénieurs et Techniciens du Cinéma, held in Paris, on 27th January, 1950, it was announced that the three-year period of office of its first President, Mons. L. Didiée, had expired.

Mons. J. Vivié, Secretary, announced that the governing body had recommended the appointment as President of Mons. G. Mareschal, which appointment was ratified, Mons. Didiée was given the title of Premier Président d'Honneur.

FILMS FOR AFRICANS — 1910 or 1950?

Norman F. Spurr, M.B.K.S., A.R.P.S. *

Read to the B.K.S. Sub-Standard Film Division on 15th March, 1950

FILMS for Africans ! What Africans ? The Africans of towns and cities, or their more primitive brethren ? The Africans with whom we shall be mostly concerned this evening are the illiterate peasants amongst whom I have worked in East and West Africa

However, let it be made quite clear that because these people can neither read nor write they are by no means uneducated. We are dealing with people who are emotionally adult but technically immature. The peasants with whom I have personally come in contact are but a fraction of the populations of Nigeria and Uganda, and an infinitesimal part of the population of the African continent, but they have this in common, their experience of film is nearer that of 1910 than 1950, for they see films rarely, and there are no sound films.

Mental Level of Audiences

In the educational world there are well-recognised age groups within which it is possible to postulate an " average " child and be sure that teaching aimed at this " average " will benefit most of the individuals within the group. In the same way, cattle owning nomads such as the Masai of Kenya, the Karamajong of Uganda, the Fulani of Nigeria, have a common set of characteristics and problems which enable us to talk about them as if they were a single generic group. This " average " results from a common way of life.

One of the tasks facing those making films for the audiences we have in mind is the discovery of a technique which will influence an " average " illiterate, for once discovered—presuming it is possible—this technique will be reasonably valid for similar audiences wherever they are found. The almost universal appeal of Chaplins and Westerns in the days of the silent film show the problem was once solved in the world of entertainment.

The kind of audience we have in mind is the illiterate peasant ; what kind of film do we produce for him ? My own work with the Nigerian Government and with the Colonial Film Unit in Uganda was to make films for instruction, education, and information. In both cases the work was financed from public funds and suffered the advantages and disadvantages of such an arrangement. There are certain functions of Government which, because they earn revenue as a direct result of the services provided, can be judged as a paying proposition from a commercial standpoint ; a railway system can be so judged. But how are we to judge an educational film service ? The revenue is nil, and the cost is met from the public purse. In the commercial world a picture must be successful at the box office, and this is true irrespective of any artistic merit it may possess. This standard cannot apply, at present anyway, to films for Africans, because the box office is non-existent.

What standard are we to adopt ? We must reject any standard based upon attendance records ; to claim so many people have seen so many films over a given period of time is an interesting measure of what is done, but no measure at all of its effectiveness.

Methods of Presentation

At the moment, and for some considerable time to come, it would seem that the mobile kinema van will be the instrument by which films are taken to

*Colonial Film Unit

their audiences. In the two Colonies where I have worked, the vans and their staff came under the control of the Public Relations Department. An itinerary of weeks, or months, was arranged, and the van set out on tour. The programmes consisted of films dealing with agriculture, health, social welfare, etc., and invariably finished up with a comedy, generally a Chaplin. A commentary was given over a microphone in the local language so that the films might be followed, but rarely was there present any official of the Department concerned to follow up the impact of the film.

This was not my idea of the use of films for mass education, for I suggest that only with literate or pre-educated audiences is it possible for a film to be teacher on its own. The major criticisms of this particular method of presentation are the lack of the necessary supervision ; the programme is too diffuse, too many ideas are presented at the same time. There is no " follow-up," and above all there is no authority behind the film. If the films about which we are thinking are to fulfil the terms of their directive, I submit the ideas concerning them must spawn from the classroom until such time as it has been proved that our audiences are capable of absorbing a less direct approach. It therefore follows that films on agriculture should be presented by the Agricultural Department as part of their extension methods. The expert should always be in attendance to answer questions, stimulate discussion, encourage endeavour ; then the film becomes an instrument capable of injecting new ideas into the very blood-stream of the people.

The Colonial Film Unit, which is incongruously enough part of the Central Office of Information, is not only responsible for making films in the Colonies, but advises the Colonial Governments on film matters, and over the years the Producer, Mr. W. Sellers, and Mr. George Pearson, Associate Producer, have played a large part in development. Sellers brought to the problem the practical experience of a pioneer who had not only made films, but had used the films he made in health propaganda for Africans[1]. I was fortunate in following in his footsteps in Nigeria. George Pearson, pioneer of the British Film Industry, brought to the problem practical experience of teaching, as an ex-headmaster ; and of course that wealth of knowledge of film-making gained when films had to tell their story by pictures or perish. A further influence has been at work in the shape of the personnel recruited for the various units of the C.F.U., and as members of the modern film industry they have brought to the problem current practices and attitudes associated with the coming of sound.

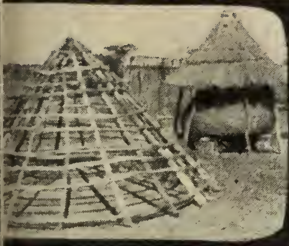
Assessment of Results

It is one of the misfortunes of work in this field that, for the most part, the theories governing the making of these films depend upon information gained at first hand over twelve years ago, largely due, in my view, to the unfortunate separation of production and exhibition. If there is one thing required above all else it is accurate data regarding the effect of the films upon the audience. Over-enthusiastic reports by van operators, or biased reports from apathetic officials, are poor foundations for valid information. To claim that audiences liked the films, or counting heads, is little better.

Because of this we tried to devise some system of assessment in Nigeria which would be an improvement on past methods. What we wanted to do was impossible, that is a full-scale test, with control groups, stretching over a period of time ; instead we sent out amongst the audiences trained observers whose task it was to note down the free comment they overheard during the showing of the film. On no account were questions to be asked, and the information was to be gathered with the minimum of fuss. In Uganda we used a disc recorder to get similar information, as exhibition and production were separated.

[1] *J. Brit. Kine. Soc.* **4.** *No* 3, July 1941, p. 104.




Building a Native House (enlargements from the 16 mm film "Trees are Cash.")

We hoped the educated African would prove a useful guide to the reactions of his illiterate fellows, but unfortunately all too often his opinions were coloured by racial sensitiveness, political axe-grinding, the desire to say the right thing, and sheer ignorance. When these inhibitions did not exist, there was no better guide.

Canons of Production

Although the method is open to criticism from a strictly scientific point of view, it was capable of yielding results as accurate as that of litmus paper when separating acid from an alkali. What did we find? In the main an almost complete vindication of the theories already governing the making of such films. Shots needed to be left on the screen for an appreciably longer time than with films for European audiences; there must be a simple aim; we found that bad visual continuity was the cause of more misunderstanding and confusion than close-ups or change of angle.

In addition, we found it quite useless to depend upon the commentary to give any information that was not very closely linked with the picture on the screen; moreover, when the visual completely absorbed the attention the sound-track was ignored. Our audiences were so parochial that a film on so basic a subject as "How to Wash" was severely criticised in Uganda by the Baganda because the Baganda wash their heads first, whereas in the film the Nigerian child is shown washing his head last. Finally, the manner in which the films were used made a great difference.

We should at this stage, I feel, concentrate upon the use of film in mass education as a teaching aid, and this means that films must be used by the Departments of Government for whom the films are made, so that films are never made in a vacuum. They will be concerned with problems already in existence or likely to come into existence. Let us take an example.

In Teso County, Uganda, the problem facing the Forest Department is the recalcitrant attitude of the peasant farmer who is suspicious of all land put aside for growing trees, for he argues such land cannot be used for cultivation or grazing. Nevertheless, this same farmer needs wood for fuel and for poles used in house building. A few, far too few, peasant owned plantations exist, but no tradition of tree planting has taken root. Eventually we decided to concentrate on trees as a source of revenue and a source of poles for building. "Trees are Cash" was made with the Forest Officer of the area as supervisor and it was intended for use by him and his staff. We adopted the narrative-teaching form of film shape, and so told a story of a man whose adventures made him realise the value of home planting, and who is taught in the film the technique of planting cassia seed.

Production Problems

A serious difficulty was one of language. I had to tell the Forest Officer what I wanted, whereupon he translated it into Swahili for the benefit of the chief, and he translated it into Eteso for the benefit of the actors. Any breakdowns in this rather tenuous link only revealed themselves when shooting commenced. It was more than disconcerting to find upon starting a scene your principal character, instead of coming to the camera, mounting a bicycle and setting off in the opposite direction.

What an audience brings to the film is of no less importance than what the film brings to the audience. This raises a difficulty to which there seems no ready solution other than reliable data on audience reaction. Two audiences sit in judgment upon our films. One audience is composed of Europeans or educated Africans who bring to the films their own experience of film going. Is it to be wondered at that so often they fail to understand why tempo must be slower, why action cannot be short-circuited? The other audience is the illiterate who still says, " There is a chicken " and " Why don't they leave it on longer?" Time will close this gap, and in those places where films have been used extensively and continuously for a number of years, 1910 may well give way to 1950 with increasing rapidity.

As a result of audience reaction tests to a Disney health film we introduced a moving diagram into a film of cattle breeding, in order to show increases in milk yield. Whether this will be understood remains to be seen.

All these films were made with the aid of a Bolex H.16 camera with the standard set of lenses ordinarily sold with the camera. Other accessories were a geared-head tripod of substantial proportions, reflectors, and exposure meter, and actors found on location. Providing existing lighting conditions were reasonable we accepted them.

Films from other Sources

Is it possible to use films made for other audiences in other countries? It would seem to depend entirely upon what they are about. If the subject matter is within the experience of the audience and the film is simple and direct, the answer seems to be " yes." African locomotive drivers of coal burning engines might well profit from a film such as " Little and Often " concerned with the correct firing of an engine. In Nigeria we tried out films on the internal combustion engine with staff employed by the motor section of the Public Works Department, and the Shell films on aviation with mechanics of West African Airways. Properly used, we were convinced they had value, but of course such audiences are limited in number.

Even a cartoon film may make its point. This was amply borne out in an experiment with Disney's " Hookworm." The Africans to whom this film were shown accepted it as long as it remained reasonably normal in its approach. The final sequences where a spade appears out of the sky, a hole is dug in a single whirl of movement, etc., were quite beyond them and put down to white man's magic. We felt the success of the film, a 100 per cent. turn-out for treatment, was due to previous knowledge of the subject which the film vitalised, and the additional fact that although the film was made for South America, hookworm symptoms, life cycle, and cure are the same wherever the disease is found.

We started with the question, films for Africans, 1910 or 1950? Perhaps this is not the right question to ask ; it implies concern with means rather than with ends. Once we have decided what place films have to take, with other visual aids, in the mass education of the African, we shall not be tempted to worship the false gods of technique. Any technique is permissible provided it achieves the desired end within the finances available, but my own inclination is to follow present theories until such time as they prove false or outmoded, and these theories are nearer 1910 than 1950.

The paper was illustrated by the projection of sequences from three films : " No Tax, no Improvement," " Trees are Cash " (both C.F.U.) and " Hookworm " (Walt Disney).

HIGH-DIFFUSION SCREENS FOR PROCESS PROJECTION

Hugh McG. Ross, M.A.*

THE rôle attributed to the screen in process projection often combines a mixture of wonder at what seem to be most peculiar effects with an unhappy neglect of several important properties. The light from the projector falls on the screen and is there scattered, and we must consider what happens to it to reach the camera.

I. REQUIREMENTS OF TRANSLUCENT SCREENS

It is helpful, perhaps, to compare back projection with the front projection so familiar in the theatre. There is no basic difference between the formation of the picture by front or back projection. In each the light falling on different parts of the screen from the projector is modified by the silver or dye image in the film or slide in the projector gate ; in the light parts of the picture most of the light is transmitted, in the dark parts little is transmitted. The objective lens of the projector throws a real image of the film or slide and focuses it on the screen. The picture on the screen is not a virtual or aerial image—it is a pattern of greater or less light, all in one plane.

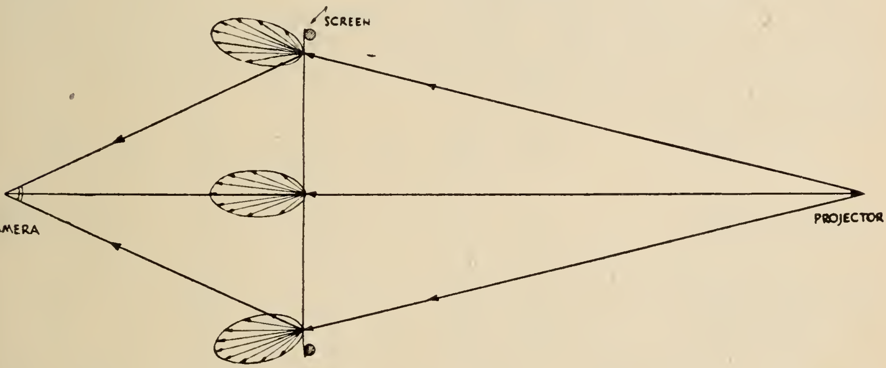


Fig. 1. The way in which light is scattered on passing through a diffusing screen. The length of each arrow represents the intensity of the light in the direction of the arrow, and the polar curve joins the tips of the arrows.

The one essential difference between front and back projection lies in the manner in which the light leaves the screen and enters the lens of the camera or the eye, and to consider this we must imagine the film or slide removed from the projector and the blank screen illuminated. The distribution or unevenness of the brightness of the screen which is then seen will still be present when the picture is superimposed on it.

In front projection every ray of light projected on the screen is reflected back and scattered in all directions, so that from whatever position or angle the screen is viewed, it appears to be of substantially uniform brightness.

Diffusion by Back Projection Screen

In back projection very little of the light is reflected, and most of it passes through the translucent screen, and in doing so it is scattered to some extent. The effect may be shown diagrammatically as in Fig. 1, where there are three

* Formerly of J. Arthur Rank Productions, Ltd.

similar polar diagrams. In these, the directions of typical rays of light are shown by the arrows, and the length of each arrow indicates the intensity of the ray in that direction. The polar curve itself joins up the tips of all the arrows.

The angle between the incident ray and the screen makes little difference to the curve (in practical conditions), so that with a screen of uniform thickness all over its area, the polar curves are the same in the centre and corners.

However, when the screen is photographed or observed from the camera position, the intensity of the light coming from the centre of the screen is greater than the intensities from the edges and corners.[1] It is inevitable, therefore, that the point on the screen which is on a direct line between the projector and camera lenses will be brightest, and the brightness will fall off steadily towards the corners. This effect of a strong " hot-spot " in the picture has in the past been very marked, and has been one of the chief disadvantages of back-projection, since the means used to overcome it consumed much time on the studio floor, or gave rise to an unsatisfactory picture in theatre back projection.

Camera and Projector Lens Angles

The magnitude of this non-uniformity over the screen depends on the angle through which the light is diffused at the corners, this angle being the sum of the angles from the camera and projector lenses. The table gives these angles for typical lenses. (Semi-angle, between axis and corner of aperture ; standard 35 mm. sound camera aperture, 22 mm. × 16 mm. ; 35 mm. process projector aperture, 24 mm. × 18 mm. ; still projector aperture, 3 ins. × 2.2 ins. ; for other apertures the focal lengths should be changed proportionately.)

35 mm. Camera Lenses :									
Focal length	mm.	25	28	35	40	50	75	100	
Corner angle	deg.	28.6	25.9	21.2	18.8	15.2	10.3	7.8	
35 mm. Process Projector :									
Focal length	ins.	2	3	4	5	6	7	8	9.25
Corner angle	deg.	16.4	11.1	8.4	6.7	5.6	4.8	4.2	3.6
Still Projector, 3 × 2.2 *ins. :*									
Focal length	ins.	6.4	8	10	12.5	14	16	18	22
Corner angle	deg.	16.2	13.1	10.5	8.5	7.6	6.6	5.9	4.8

It will be noticed that for the great majority of process shots the total angle through which the light is diffused at the corners of the screen is in the range 15° to 30°, taking typical camera lenses 35 mm. to 75 mm. and typical moving projector lenses 4 ins. to 6 ins. The first important fact derived from this table is that the camera lens contributes far more to this angle than does the projector lens. The second important fact is that a large increase in the focal length of the projector lens, requiring a great increase in the projector throw behind the screen, makes only a small difference to the total angle.

We wish, of course, to keep this total angle as small as possible, so it is desirable, but not essential, to use camera lenses of fairly long focal length. For the same reason there has arisen a tradition of using long projector throws, for the throw is directly related to the angle—*e.g.*, for a given size of picture almost exactly the same throw is required by 75 mm. camera lens, a 3.2 inch moving projector lens or a 10-inch still projector lens. But the situation soon arises when any further increase of projector throw gives no *significant* improvement in the light distribution over the screen. Consequently, we arrive at the simple working rule that *the projector throw should be about twice the camera throw*. This applies when the projected background is filling the camera gate ; should it fill only a part of the scene (in the case of views through windows, etc.) the projector throw can be reduced still further. The chief exception to this rule is in close-up work with small backgrounds, when it is desirable to use a greater throw to reduce the noise from the projector. With modern projector lenses there is no reduction of definition with the short focal lengths.

Brightness over the Screen

A more useful way of drawing the polar diagram is shown in Fig. 2. The angle through which the light is diffused is shown on the horizontal axis, the centre representing the straight line between projector and camera lenses. The brightness of the screen when viewed from each angle is now shown vertically, and a logarithmic scale is used because both the eye and photographic emulsion have logarithmic characteristics and this, therefore, represents the effect as observed or photographed.

These measurements are made by projecting a steady light on the screen and then observing the brightness of a small area of the screen from different angles by means of a narrow-angle photometer. The Morgan Reflectometer[2] has been used, and also the S.E.I. Visual Photometer.[3] The units used represent the brightness which would be obtained if the incident light were reflected back by a Lambert surface, a perfectly white, matt reflector, and may be termed the "brightness-factor." In practice a white test surface of known reflectivity is first held against the screen and measured from the projector side to calibrate the instrument and light source.

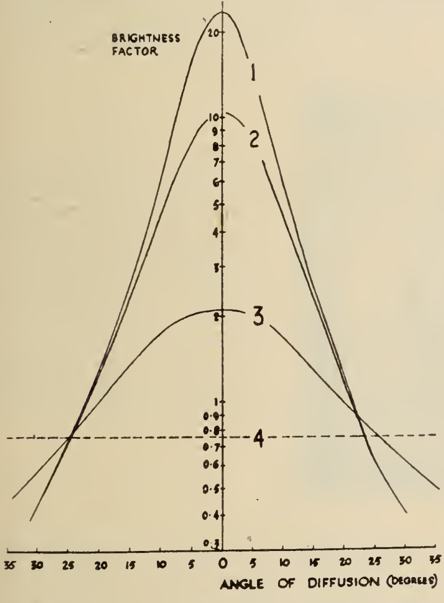


Fig. 2. A preferred way of drawing the polar diagram. Curve 1, measured at corner of typical graded screen in normal use; curve 2, measured at centre of the same screen; curve 3, new high-diffusion screen; curve 4, nominal performance of good front-projection screen for comparison.

If a uniform screen is used, made with the same thickness of diffusing material all over its area, the brightness across the screen, as observed from the camera position, is rather similar to this polar curve. If, on the other hand, a non-uniform or graded screen is used, made with additional diffusing material near its centre, the complete brightness distribution curve cannot be assessed so easily. However, by measuring the polar curves at the centre and corner, as shown for a typical screen of this type by the two upper curves of Fig. 2, the brightness at the centre is given by the centre-curve at 0°, and the brightness at the corners is given by the corner-curve at the appropriate angle for the corners, say 25.5° for a 40 mm. camera lens and 5-inch moving projector lens. The brightness across the screen will, of course, gradually fall off from the centre brightness to the corner brightness.

Overcoming Hot-Spot

The two upper curves of Fig. 2 are for the best type of graded screen hitherto available, and show that if the projector side of the screen is uniformly illuminated, the centre is 15 times brighter than the corners at 25°, for the typical set-up mentioned. This causes a marked hot-spot, and it has to be overcome by placing metal discs in the centre of the light-beam, near the projector lens, which reduce the intensity of the light falling on the centre of the screen. With skilled use these discs need not reduce the intensity of the light falling on the edges and corners of the screen, but it always takes a considerable time to position them. They also introduce very severe restrictions in the movement of the camera, and with them it is very difficult to do satisfactory tracking shots.

Further, due to the fact that the discs prevent the rays of light from the centre part of the objective lens from falling on the centre of the screen, the most important part of the picture may therefore lose definition because it is only lit from the marginal parts of the lens which may be less well corrected than the centre.

Hot-spot has now been overcome by new high-diffusion screens, an example being shown in Fig. 3 for which no hot-spot correction was used. These screens are of uniform diffusion over their whole area, and a typical polar curve is also shown in Fig. 2. The first important point is that the centre is only two or three times as bright as the corners. This is found in practice to be better than an even smaller ratio, for when there is a picture on the screen the

(Courtesy, Aquila Film Productions)

Fig. 3. Process projection was used for the sky in this shot from "Stop Press Girl," which shows the complete elimination of "hot spot" obtained with a high-diffusion screen. No correction devices were used at the projector. If there was any unevenness in the brightness across the screen, it would show up in this type of shot.

non-uniformity is not noticeable even when re-photographed, probably due to the fact that the edges appear brighter to the eye than they really are, in contrast to the dark surround of the theatre screen. Further, this degree of non-uniformity gives an added life or vitality to the picture, because good bright highlights are obtained in the centre of the picture and full deep blacks at the edges, and the eye sees both these effects at once and, not distinguishing them, combines them into one impression of enhanced quality.

Brightness of Corners

The second important fact now revealed is that this additional diffusion does not alter the intensity of light diffused through angles of about 25°. Since this angle represents the corners of the screen in typical set-ups, the brightness of the edges and corners of the screen is therefore not reduced. This is most important, for of course it is these areas, being the least bright part of the picture in any case, which limit the exposure obtainable at the camera. With these high-diffusion screens less light is being transmitted at very small angles of diffusion, and it is instead being diffused out at much greater angles (which are not of much practical value in studio process projection) ; it just happens that at the angles of interest for process work the various curves overlap and the corner brightness remains virtually the same with wide variations in the thickness of the diffusing layer.

Practical Performance

About two years' experience with these high-diffusion screens has shown that the great majority of shots can be thrown up on the screen without any hot-spot being noticeable (in any case it is now only a gradual brightening of the centre of the picture). This has resulted in a great saving of time and trouble on the studio floor. Only on rare occasions is a disc or small metal plate placed in front of the projector lens, and this is only to bring down the brightness of a local part of the picture to suit the lighting-cameraman's balance with the foreground. A particularly severe test is that successful Technicolor back projection shots are now normally made without any steps being taken to reduce the additional brightness at the centre of the screen.

The advantages of these high-diffusion screens for theatre back-projection are immediately obvious, and this may be clearly demonstrated by moving about in front of one of them, observing the uniformity of illumination.

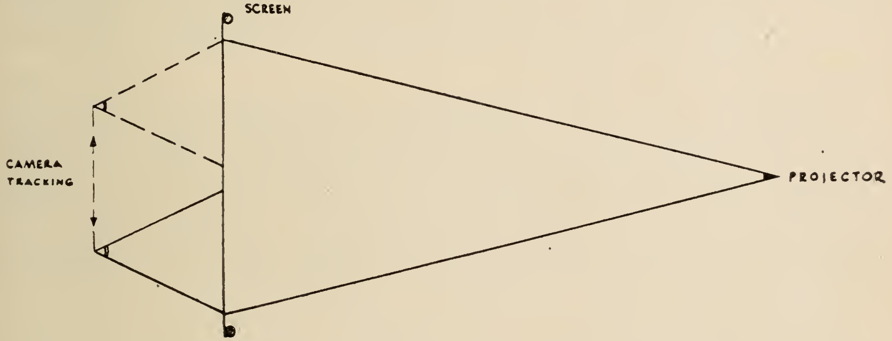


Fig. 4. Diagram showing camera tracking parallel to screen. High-diffusion screens permit considerable camera movement.

Freedom of Movement of Camera

The various devices which have to be used with old-type screens to reduce the hot-spot have to be positioned in relation to the camera position, and consequently if the camera is moved the hot-spot is not properly cancelled, with very adverse results. An important practical result of using high-diffusion screens, thereby doing away with these devices, is that it becomes possible to track and pan the camera to a great extent.

Fig. 4 shows a set-up with the camera tracking parallel to the screen. Since the effect of the centre being brighter is controlled solely by the properties of the screen, no change of distribution of the light over the picture in the camera is noticeable, although there is in theory a slight shift of the centre of the bright area within the picture, because the centre always lies on the straight line adjoining projector and camera lenses. A uniform or non-graded screen is of particular importance in this connection.

In Fig. 5 the camera is shown tracking into (or away from) the screen. Since there is only a small change in the angles of the light at the corners of the picture, there is no noticeable alteration in the distribution of light within the picture area ; we may note that the size of the brighter part (if this be defined in any arbitrary way) remains the same size in the camera aperture, although it covers a smaller part of the screen and picture. Of course there is an increase in the apparent size of the background as seen by the camera and

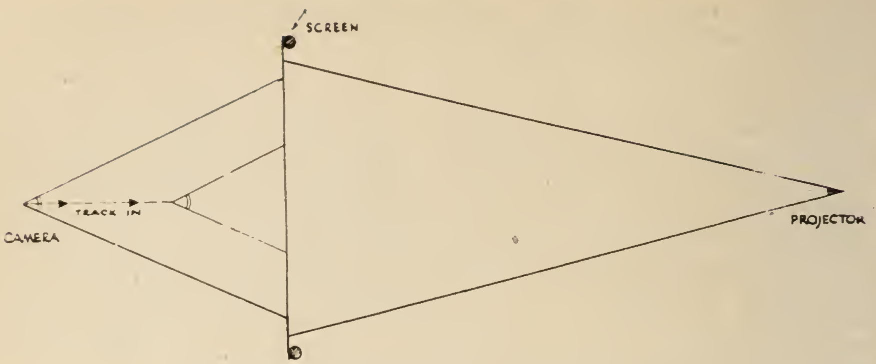


Fig. 5. Camera tracking towards or away from screen.

any resulting errors of perspective and scale may limit the amount of tracking possible. This effect could be overcome by using a zoom lens in the projector. With a moving projector the grain and the reduction of definition may become noticeable due to photographing only a small part of the frame in the projector.

Panning and Tilting the Camera

The high-diffusion screens also permit a considerable amount of panning and tilting of the camera. At the beginning of the panning movement shown in Fig. 6, the angle at the left-hand side of the picture is greater than at the right-hand side, and consequently the left of the picture will be rather less bright than the right. As the camera pans across, the condition will be gradually reversed, and the left side will become the brighter. But due to the flatness of the polar curve, Fig. 2, quite a large change of angle makes only a relatively small change of brightness. Of course exactly the same thing occurs in tilting the camera.

All the camera movements so far considered may be combined, and it is now frequently done to track diagonally from the screen, panning and tilting at the same time, with completely acceptable results. The main limitations to the amounts of these movements in practice are the available sizes of screens, and the errors in perspective and scale.

Positioning of Projector

A useful feature of high-diffusion screens is that they make it unnecessary to position the projector very accurately. Previously the projector had to be placed on a straight line passing through the centre of the screen from the

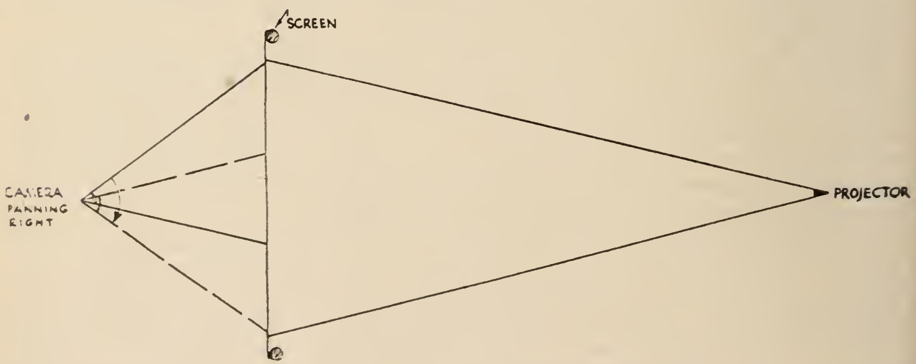


Fig. 6. Camera panning across screen. The same considerations apply to tilting the camera up or down.

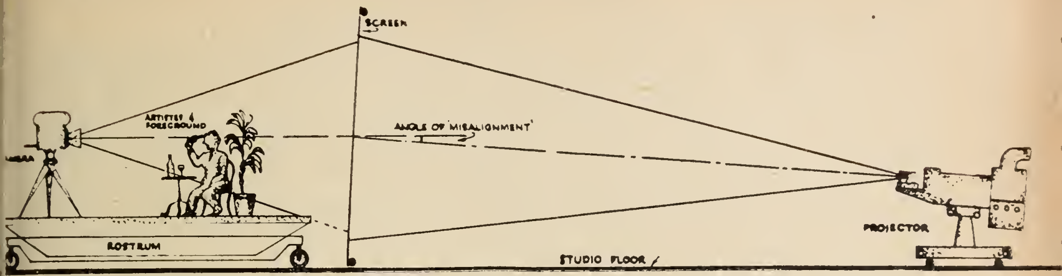


Fig. 7. Illustrating the term "angle of misalignment." With high-diffusion screens there is considerable latitude in positioning the projector.

camera. Now, the distribution of light over the screen is not significantly affected by a " mis-alignment " of up to 5°, as shown in Fig. 7. This makes it possible to keep the projector on the floor for the great majority of shots, and it also simplifies the design of the projector in one important respect because it does away with the need for an adjustable vertical column, this having big mechanical advantages.

The small amount of " keystone effect " which would be introduced can be cancelled completely by tilting the screen slightly, not more than 3°.

Effect of Scale

All the effects described are independent of the scale of the set-up ; each of the figures applies equally well whether the picture is 5 ft. or 50 ft. wide. Contrary to what is often thought, the process projection itself will not be altered as the size of the background is increased, and the only change required with a larger picture is to increase the total light output of the projector, to maintain the same brightness ; thus, if the area of the picture is doubled, twice the light output is required or, alternatively, the camera lens must be opened up one stop. Even the definition is not affected, when the film or slide in the projector is photographed down on to the camera gate ; although of course the larger the picture the worse the definition will appear if one stands near the screen itself.

Measurement of Light

Due to the fact that the light passing through a diffusing screen is scattered in all directions, and only a tiny fraction of it reaches the camera lens, it is valueless to make any measurements of the transmitted light by placing against the screen the usual type of photo-electric exposure meter or photometer. These pick up the light over a very wide angle, which is entirely different from the manner in which the light reaches the camera. In particular, the usual measurement of the " transmission " of the screen is most misleading.

The only method of making light measurements on a diffusing screen which have any real meaning is to use a narrow-angle photometer, and preferably stand at the camera position. The S.E.I. Visual Photometer has been found to be particularly suitable, although a photo-electric meter may be used if it is shielded by a long narrow tube to reduce its acceptance angle, and it is recalibrated as a brightness meter.

As a guide to the exposure required for process work, the brightness (measured in foot-lamberts) of a part of the background which is required to photograph a full white, should be about three-quarters of the figure (in foot-candles) of the foreground key-light. Consequently, a high-light on the screen of about 75 foot-lamberts will expose well at *f*/2.8 on Plus-X stock, this corresponding to a key-light of 100 foot-candles. When narrow-angle photometers are not used, it is usual to balance the brightnesses of the background and foreground visually, and determine the camera stop by the foreground key-light.

II. EXPERIMENTAL STUDY OF SCREEN PROPERTIES

A systematic study has been made of diffusing materials for screens, with a view to finding out which properties are important for the quality of the screen, and also the other properties which have no useful effect. Both the diffusing material and the main material of which the screen is made must be colourless and should be unaffected by age, weather conditions or being washed. The materials should also be in themselves transparent so that no light is lost by absorption, and the diffusing effect will be obtained by scattering of the light at the boundaries between each particle of diffusing material and the base material in which it is embedded.

The base material is preferably a plastic, and the most suitable are ethyl cellulose or cellulose acetate, the former being particularly easy to use and spray. These are strong and " non-inflammable." Finely-powdered optical glass was chosen for the diffusing material in these experiments because it fulfils the above requirements ; the choice was satisfactory for, as will be shown later, with the correct glass it is possible to make a screen as good as any other type.

Apart from obtaining a strong, colourless screen, of good texture and of uniform diffusion all over its area, the main point to be considered is the shape of the polar diagram of the light transmitted through the screen. We wish

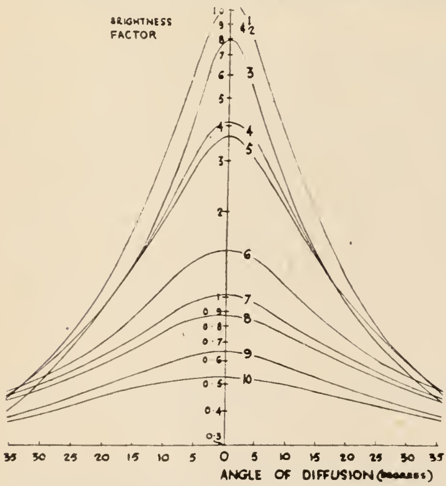


Fig. 8. A family of curves obtained with powdered glass of refractive index 1.82 in ethyl cellulose base. Curve 1, coarse glass particles, cast; 2, fine particles, sprayed; 3, medium-sized particles, sprayed; 4, medium-sized particles, sprayed, two screens placed together; 5, glass of mixed sizes, cast; 6, medium-sized particles, sprayed, two screens placed together; 7, glass of mixed-sizes, cast; 8, fine particles, sprayed; 9, fine particles, cast; 10, fine particles, cast. Curves 2, 8, 9 and 10 have increasing weights of glass; similarly, curves 4 and 6; and curves 5 and 7.

the straight-through brightness-factor to be not too great (to reduce hot-spot) and we also wish the brightness-factor at angles of about 25° to be as much as possible to ensure high corner brightness.

Effect of Quantity of Diffusing Material

The first point established was the effect of changing the quantity of diffusing material. Many samples were prepared made of the same plastic base and diffusing material, but increasing amounts of the diffusing material were incorporated. Fig. 8 is typical of the results. It is seen that over a wide range an increase of diffusion reduces the straight-through brightness factor, but it makes little difference to the brightness factor at 25° or 30°. This effect gives the control over hot-spot. The preferred diffusion for process screens is with the centre brightness factor in the range 1.5 to 2.5 If, however, the diffusion is increased too much, making the curve fairly flat, the brightness factor at these angles also begins to fall. Ordinary opal glass is similar to the lowest curve shown.

Factors which do not affect the Diffusion

Next, all the qualities which might possibly affect the diffusion were studied, and it was established that there are many factors which are of no consequence. One type of glass and one plastic base material were used, and all the curves obtained fit the one family shown in Fig. 8, and other similar curves.

(i) It does not matter whether the diffusing particles are on or near the surface or embedded throughout the base. A surface coating or " dusting " is similar to a comparatively small amount of diffusing particles embedded in the base. There is a limit to the amount of diffusion obtainable with a surface coating strong enough to withstand handling, and with such screens hot-spot is visible.

(ii) It makes no difference whether the diffusing material is incorporated in the liquid base plastic and cast on to a matrix, or whether the screen is built up by spraying a mixture of diffusing material and plastic lacquer.

(iii) The same diffusion is obtained by one high-diffusion screen or two low-diffusion screens placed close together. The latter effect may of course be obtained by spraying diffusing layers on both sides of a single screen. If two ordinary screens are placed together in one frame it is not possible to obtain close contact between them and consequently the light is scattered in passing through the first and

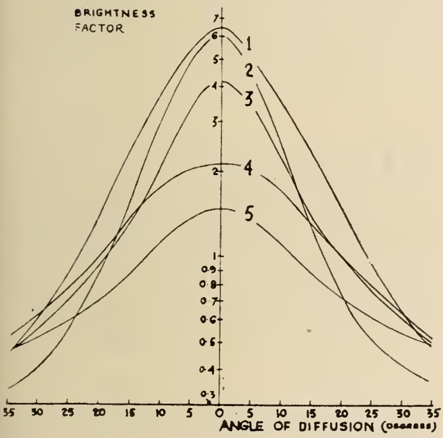


Fig. 9. To show the effect of altering the refractive index of the powdered glass. Curves 1 and 4, ref. index 1.61 give the best results; curve 2, ref. index 1.465; curves 3 and 5, ref. index 1.82.

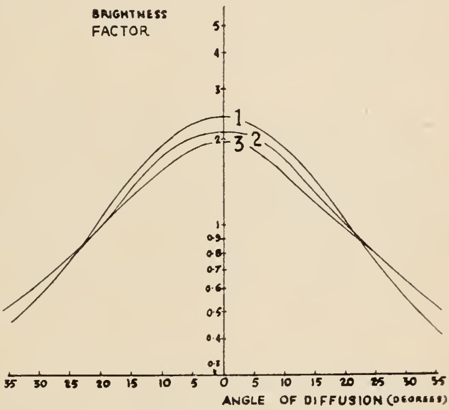


Fig. 10. Comparison of screen made of powdered glass of refractive index 1.61 in ethyl cellulose (curve 2), with commercial high diffusion screens.

a slight loss of definition is observed, especially towards the corners. With backgrounds over 14 ft. wide, however, this does not show in the final photograph.

(iv) Over a considerable range, the size of the diffusing particles makes no difference to the type of polar diagram. It is probable that the amount of diffusion is chiefly controlled by the number of particles, so that the finer they are, the less weight of diffusing material is required. The largest particles should be considerably smaller than the thickness of the screen (about 0.012 ins.), and the smallest should be several times larger than the wavelength of light, or coloured diffraction effects may be obtained.

(v) It is immaterial whether the diffusing particles are of substantially uniform size or of mixed sizes, except that different weights will be required for a given diffusion. We have found it very satisfactory to use powdered glass sieved to pass a 200 mesh.

Effect of Refractive Index

The most important fact revealed by this investigation is that the shape of the polar diagram may be altered by changing the refractive index of the material used for the diffusing particles. Almost certainly the important criterion is the difference between the refractive indices of the plastic base and the diffusing particles, but the indices for all suitable plastics are similar (ethyl cellulose 1.47 ; cellulose acetate 1.49-1.50) so that the index for the particles is the most relevant.

Samples were made using ethyl cellulose and three types of powdered optical glass of different refractive indices, the results being shown in Fig. 9. Curves 1 and 4 are for the best glass tested, having a refractive index of 1.61, and for the preferred range of straight-through brightness-factor, the 25° brightness-factor is about 0.8. The glass of refractive index 1.465 (curve 2) gives markedly inferior corner brightness ; much the same curve is given by a surface roughening, such as a dry spray of the plastic. A glass of high refractive index, 1.82, gives curves 3 and 5, the 25° brightness-factor being about 0.65.

These glasses cover adequately the range of optical glasses and it is very satisfactory that the optimum occurs with a readily available glass. The possibility of using powdered white diamonds was considered because of their very high refractive index, 2.4, but was turned down on the grounds of expense! The reason for the preferred index being about 1.6-1.7 has not been theoretically established, due to the complexity of the mathematical treatment of diffusion by randomly-shaped particles, but it is considered that this experimental approach is adequate.

Comparison with Commercial Screens

It is of interest to compare in Fig. 10 the curve (No. 2) for a screen made of powdered glass of refractive index 1.61 in ethyl cellulose with the best commercially available screens. Curve 1 is for American sample screens probably utilising a dry-spray of ethyl cellulose. To obtain the necessary high-diffusion two sheets of screen material were put together, each being sprayed on both sides ; there were therefore four diffusing surfaces. Curve 3 is for a British high-diffusion screen, comprising aluminium stearate cast in cellulose acetate. It is seen that all types of screen are of the same high quality.

III. METHOD OF MANUFACTURE OF SCREENS

High-diffusion screens and the use of powdered glass in the making of them as described above a recovered by patent protection,[4] and there is also mentioned a method of manufacturing such screens. The process, which has been specially adapted for constructing very large screens, consists of spraying the cellulose lacquer on to a false ceiling, for some of the layers powdered glass being mixed with the lacquer.

The ceiling used is constructed of ordinary trowelled plaster on the usual laths, supported from a suitable framework. This provides a surface as large as required for any studio application, completely free from joints. By using a false ceiling and spraying from below, it is easy to reach any part, and no dirt falls on the screen during manufacture.

The plaster is prepared by spraying on to it a gelatine solution which is made to bond well into the plaster. When dry this gives a layer from which the screen may be stripped and since it is not damaged, it may be used for many screens. The gelatine tends to fill the " pores " of the plaster and leaves a satisfactory surface to the back of the screen.

The main base of the screen is then made by applying ethyl cellulose lacquer with a powerful spray gun, the process being very simple. An obvious development, if very large sheets of plastic material were ever required for any purpose, is to build up a rather thicker layer and then strip it off before applying the diffusing material.

Fabric tapes are then applied, which are to strengthen the edges of the screen for stretching it in its frame. Complete adhesion is easily obtained, and since more lacquer is subsequently applied with the diffusing medium, the tape is bonded right into the thickness of the screen.

The powdered glass is next sprayed on, and this part of the process requires considerable care, for if there is any unevenness in the amount of diffusing material in the finished screen the brightness will not appear uniform. Although the eye will tolerate a difference in brightness of 2 to 1 from centre to corner of the screen, it is much more sensitive to small local changes in brightness. Such a change of about 10 per cent. can be seen by a trained eye on an " open " illuminated screen, *i.e.*, with no picture being projected. Since the overall gamma of the negative and positive process is about 1.5, this difference becomes 15 per cent. in the final projected picture in the theatre. With a still background scene such a difference is likely to be broken up and obscured by the picture. But it may begin to show with a moving background, because the blemish on the screen remains stationary and the picture moves across it. The effect is most apparent on light grey tones, clouds being a particular example.

The powdered glass is mixed into the lacquer and sprayed on. A true wet spray is obtained, and the glass particles in the droplets of spray from the gun are able to flow out ; further, the lacquer bonds together and to the clear base, therefore contributing to the strength of the screen and making a diffusing material which it is unusually difficult to damage. By careful control throughout this stage, satisfactory uniformity and freedom from unevenness is obtained.

After drying for two or three days the screen is stripped off the gelatine-treated plaster ; it is cut through all round the edges of the ceiling and, starting from one corner, is easily peeled off, coming away cleanly and leaving the gelatine undamaged. It is laid on the floor, cut to exact size and eyelets set at every 4 ins. into the tape round the edges. A frame is placed over the screen and the screen laced into it with elastic bands. It is then ready for use. Alternatively, it may be rolled up for transport without being damaged.

Acknowledgments

Many people have co-operated in this work. The projection techniques described in Part I were established using high-diffusion screens with the required polar diagrams made by Stableford All-Metal Screens, Ltd., and were introduced into normal production use largely by Mr. Charles D. Staffell, senior process projectionist at Pinewood Studios. The preparation of the sample screens used in the investigation of Part II was made by Dr. F. P. Gloyns, assisted by Mr. G. C. Ives, of Dr. V. E. Yarsley's Research Laboratories, Ewell, Surrey, who also worked out the spraying technique on gelatine-treated plaster. Mr. H. M. Levermore, of Cellon, Ltd., Kingston, has contributed greatly to the actual making of the screens described in Part III, working with Mr. Ted Keith and Mr. Wally Martin at Denham Studios. Throughout the work, particular assistance has been given by Dr. B. V. Bowden, and other members of Sir Robert Watson-Watt and Partners, Ltd., scientific consultants to the J. Arthur Rank Organisation, Ltd.

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1. See also *Brit. Kine.*, **12**, No. 4, Apr., 1948, p. 128 ; also *Bull. Off. de la Commission Supérieure Technique*, July, 1947, p. 159.
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4. Brit. Pat. 27,812, 1949.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library.

SIMULTANEOUS DETERMINATION OF ELON AND HYDROQUINONE IN PHOTOGRAPHIC DEVELOPERS

H. L. Rees and D. H. Anderson, *J. Soc. Mot. Pic. Eng.*, September, 1949, p. 268.

A sample of the developer solution is diluted with a *p*H 5 acetate buffer and its absorbency (optical density of solution relative to solvent) measured at two wavelengths in the ultra-violet region. The concentration of Elon and hydroquinone in a fresh unused developer solution can be determined directly from these two absorbencies. Used or old developer solutions are analysed by extracting the unoxidised Elon and hydroquinone with ethyl acetate. Absorbency measurements made on the system before and after extraction serve to determine the amount of Elon and hydroquinone present. AUTHORS' ABSTRACT.

EFFECTS OF FILM SHRINKAGE

G. Rohloff, *Foto-Kino-Technik.*, September, 1949, p. 216.

Film shrinkage relative to a feeding sprocket results in discontinuity of movement, and in the case of a non-intermittent projector, in picture unsteadiness. The magnitude of the fault is discussed, and methods of correction considered. R. H. C.

LUBRICATION OF 16 mm. FILMS

Ralph H. Talbot, *J. Soc. Mot. Pic. Eng.*, September, 1949, p. 285.

It is desirable that 16 mm. release prints be lubricated by film laboratories, but edge waxing as employed for 35 mm. prints is unsuitable because the sound track is affected. Overall lubrication of the emulsion surface is a method employed and solutions employing solvents of a low order of toxicity are suggested to replace wax-carbon tetrachloride formulae.

H. S. H.

MIRROR OBJECTIVES

J. Reiner, *Foto-Kino-Technik*, September, 1949, p. 218.

Optical systems employing mirrors are capable of working at wide apertures. Spherical aberration can be overcome by the Schmidt corrector plate, or by a concentric meniscus. The Mangin mirror—a silvered meniscus—avoids spherical aberration, but is subject to astigmatism, which can be overcome by the use of a meniscus lens. Various systems are compared and their applications illustrated. R. H. C.

DIRECT-POSITIVE VARIABLE-AREA RECORDING WITH THE LIGHT VALVE

L. B. Browder, *J. Soc. Mot. Pic. Eng.*, August, 1949, p. 149.

By reflecting light from the back surface of the light-valve ribbons and focusing the ribbon edges at the film plane a bilateral or unilateral type of direct-positive variable-area track is obtained. By re-locating the recording lamp so that the light is transmitted through the space between the ribbons a normal variable-area negative may be obtained.

AUTHOR'S ABSTRACT.

35 mm. AND 16 mm. PORTABLE SOUND-RECORDING SYSTEM.

E. W. Templin, *J. Soc. Mot. Pic. Eng.*, August, 1949, p. 159.

The basic system includes a two-channel mixer, a main amplifier including associated noise-reduction circuits, a compact recorder, and a power unit for operating the entire system from a 115-volt alternating-current supply. An optional invertor providing for operation from 96-volt batteries and an A.C. and D.C. multi-duty motor-control unit are also available.

AUTHOR'S ABSTRACT.

PROGRESS REPORT ON THEATRE TELEVISION

B. Kreuzer, *J. Soc. Mot. Pic. Eng.*, August, 1949, p. 128.

In connection with a theatre television demonstration of an instantaneous theatre television projection system, a chronological record of the early development and current progress of theatre television is presented. References are made to both instantaneous projection and the kinescope-photography methods.

AUTHOR'S ABSTRACT.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library.

PUSHBUTTON ZOOM LENS FOR TV

The Walker "Electra-Zoom" lens is adjusted for focal length by a small motor, which can be remotely controlled. Focus ranges from 3½ ins. to 8 ins., at *f*/3.5.

Amer. Cine., May, 1950.

MAKING PUNCHES LOOK REALISTIC

Added realism is lent to fight films by a camera dolly designed to receive blows from a boxer; the camera is protected by rubber pads. *Amer. Cine.*, May, 1950.

CAMERAMEN AMONG THE FISHES

Filming 100 ft. deep in the Mediterranean, Michel Rocca employed an Aquaflex, a modification of the Caméflex. Holding 400 ft. of film, it is easily loaded and handled, the dials of the speedometer, footage counter and exposure meter being illuminated.

Le Technicien du Film, **2**, No. 6.

PERFORATION STANDARDS

Arising out of the contribution entitled *Standardisation Combats Film Mutilation* to the discussion arranged by the Theatre Division, and reported recently in this journal,[1] Mr. A. C. Robertson, of the Department of Manufacturing Experiments, Kodak Park, U.S.A., writes as follows :—

"Mr. Cricks states that Bell and Howell introduced the rectangular perforation which is used to-day on all positive films. I wonder if this statement was really meant to stand as it reads ; the Bell and Howell perforation is the one commonly used for negatives to-day. It has a height of 0.073 in. and a width of 0.110 in., with curved sides having a radius of 0.055 in. This perforation was apparently proposed by Mr. Bell in 1916, and was accepted to a very large extent by 1918. Trade experience soon showed, that however good this film might be in the camera, it behaved poorly in the projector. Therefore, Mr. J. G. Jones became interested in the subject and did a great deal of experimenting at Kodak Park. It was he who proposed the rectangular perforation which was commonly used on release positives to-day. Within our own organisation, it is commonly referred to as the 'Kodak Standard' perforation.

"This perforation was designed to have a height of 0.078 in., because there were so many different 'off-standard' projector sprockets being made at that time of rapid development in the art. [2, 3] Since then, standardisation has become almost universal, and to-day there is little need for a perforation that is 0.078 in. high. This point has been recognised for some time, and was clear in Dubray's mind when he suggested the perforation recently reconsidered for use as a combination positive-negative perforation.[4] The increased use of low-shrinkage film base has further decreased the need for the additional leeway given by a perforation of this size. All this discussion of history is of interest because a number of people in the American photographic business recently requested a new standard perforation which would have the height of the older Bell and Howell perforation. Such a perforation is needed in contact printing of colour separation negatives.[5]

"I am sure that some members of your Society will find these comments of interest, just as in my own case I was particularly interested in learning about Mr. Newman's earlier work for the Kinematograph Manufacturers' Association."

The type of perforation used for negative tock originated with Edison ;[6] *it was the form standardised in the earliest British specifications, which were based upon the proposals of Arthur S. Newman, first made in* 1909.[7] *This original perforation differed however from the form eventually standardised in having a height of* 0.072 *in. instead of* 0.073 *in.*

The latter form is commonly known as the Bell and Howell perforation, the rectangular positive perforation being, as Mr. Robertson states, termed the Kodak perforation. Apologies are due for the mis-statement in the original contribution.

EDITOR.

REFERENCES

1. *Brit. Kine.*, **16**, No. 1, Jan., 1950, p. 20.
2. B.S. 677 : 1942.
3. A.S.A. Z.22.36 : 1947.
4. *J. Soc. Mot. Pic. Eng.*, **29**, No. 4, Apr., 1937, p. 376.
5. *J. Soc. Mot. Pic. Eng.*, **52**, No. 4, Apr., 1949, p. 447.
6. *J. Soc. Mot. Pic. Eng.*, **21**, No. 6, Dec., 1933, p. 435.
7. *Phot. J.*, **85A**, July, 1945, p. 153.

BOOK REVIEW

Books reviewed may be seen in the Society's Library.

THE FILM USER YEAR BOOK 1950.
Current Affairs Ltd. 10*s.* 6*d.*

For the second year, the publishers of the "Film User" have produced their Year Book, and in so doing have set an even higher standard than they did a year ago. Briefly, the object of the book is to make available current information on 16 mm. film and filmstrip matters. Information is easy to find and is surprisingly complete. For those who are interested, there are appraisals of entertainment and factual films as well as filmstrips of 1949. The classified directory of manufacturers, with their addresses in the general directory, will be of use to many, and a list of special trade names completes this portion of the book.

It would take too long to enumerate the sections of this most valuable publication, but little seems to have been overlooked—there are even lists of books and pamphlets of current interest.

H. S. Hind.

FILM AWARDS IN NORTHERN IRELAND

The Festival of Britain 1951 Committee for Northern Ireland, in association with the Belfast Film Institute Society, announces the offer of awards for documentary films made in Northern Ireland by amateurs on 16 mm. stock, of subjects connected with the life and background of Northern Ireland.

THE COUNCIL

Meeting of 3rd May, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), H. S. Hind (*Hon. Treasurer*), Rex B. Hartley (*Hon. Secretary*), B. Honri, T. W. Howard, R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Presidential Insignia of Office.—The President announced that designs had been received for the President's Badge. Other designs were being obtained, and a report to Council would be made.

Course of Lectures in Lighting.—Mr. H. S. Hind reported on the support which the course might be expected to have.

Accounts.—Accounts and cash statement to 30th April, 1950, were presented and approved.

Officers and Members of Council.—The President reported the names of the newly-elected Officers and Members of Council (see page 183).

Appointment of Committees.—The Committees were considered, and appointments made, with the exception of the Branches Committee (see inside back cover).

Journal and Papers Committee.—Consideration was given to a proposal that the Journal and Papers Committees be amalgamated on the grounds that the functions of the two Committees were closely linked, and that there was need for more liaison between the two than at present existed. The proposal was carried. It was agreed that the Joint Committee appoint two sub-committees, to be responsible for the Papers and the Journal. Mr. Wratten was appointed Chairman of the Joint Committee.

Membership Committee.—The President explained the twofold function of the Committee. All matters regarding membership would be covered by this Committee. It was agreed that the Vice-President should be Chairman, and the committee be composed of the Divisional Chairmen and one other representative from each Division.

Patron Membership.—It was agreed that in future the Hon. Treasurer should be responsible for Patron Members' subscriptions.

Mr. Honri's Letter.—The President reported that the Executive Committee had considered a letter he had received from Mr. Honri, in which suggestions had been made of ways in which the Society might make a contribution to the recovery of the Industry.

Fourth Ordinary Meeting.—The President reported on matters which had arisen at the Ordinary Meeting of the Society.

EXECUTIVE COMMITTEE

Meeting of 3rd May, 1950

Present :—Messrs. A. W. Watkins (*President*), L. Knopp (*Vice-President*), Rex B. Hartley (*Hon. Secretary*), H. S. Hind (*Hon. Treasurer*), Miss J. Poynton (Secretary), and Miss S. M. Barlow (*Asst. Secretary*).

Elections.—The following were elected :—

John Ronald Fraser Stewart (Member), Realist Film Unit and B.B.C.

Joan Jones (Associate), British Film Institute.

Robert Anderson Riddell Black (Member), Templar Film Studios.

Bryan Raymond Bentley (Member), Cinechrome, Ltd.

Transfer.—From Studentship to Associateship :—

Howard Colin Jones.

Resignations.—The following resignations were accepted with regret :—

Eric Davis Eyles (Member), Harry Francis Packard (Associate), A. Fitzgerald (Associate), Irene Wilson (Member), John Marshall Gill (Associate).

COMMITTEE MEETINGS

Sub-Standard Film Division Committee —19th April, 1950

It was announced that Mr. N. Leevers had been appointed by Council as Chairman of the Division. Papers were agreed upon for the 1950-51 Session. It was agreed that a sub-committee be formed to study improved 16 mm. film presentation. The findings of the sub-committee would be published.

Finance Committee—24th April, 1950

The accounts for the year to 31st December, 1949, were considered. They were duly adopted and signed. The position regarding Patron Membership was discussed.

Papers Committee—26th April, 1950

The dates for meetings during the forthcoming session were agreed upon. Suggested papers for this session were passed.

Theatre Division Committee— 27th April, 1950

The programme for the next Session was discussed. Demonstrations and papers had been arranged. It was stated that the date for the proposed demonstration of large screen television had not yet been fixed.

Journal Committee—28th April, 1950

The question of notepaper to be used in connection with the journal was discussed. The editorial contents for May to September were presented and agreed upon. Arrangements for promoting American sales were reported.

Film Production Division Committee—8th May, 1950

Divisional appointments were proposed and agreed upon. Divisional policy was discussed in full. The fact that there were no technical representatives of the Industry on either of the negotiating bodies with the Board of Trade was noted. Recommendations to Council regarding this matter were proposed.

ERRATUM

In last month's issue, page 157, the date of the issue of the *Optical Magic Lantern Journal* should have been shown as 15th November, 1889, not 1899.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

A. A. ENGLANDER has resigned from the Board of Directors of Basic Films Ltd., after serving for four years.

W. B. HAKES is now visiting Switzerland and Italy on a sales mission.

G. PARR is now recovering from a minor operation, and is spending two weeks convalescence on the south coast.

PERSONAL ANNOUNCEMENT

Dunlop Rubber Company requires lady Assistant Cinematographer, 22 or over, for Technical Photographic Department. Duties would include preparation of film shooting scripts, editing of 16 mm. films, preparation of title layouts, 16 mm. camera operating, ordering of films and their projection. Applicant must have I.B.F. Inter. and Inter. B.Sc., or H.S.C., and have taken two years course in Photography and Kinematography at the Regent Street Polytechnic. Experience is required in the following fields: Still and 16 mm. Sub-standard kinematography in monochrome and colour, 16/35 mm. sound film projection, recording and organisation of outside services. Apply, giving details of age, qualifications and experience, to: PERSONNEL MANAGER, Dunlop Rubber Co. Ltd., Erdington, Birmingham, 24.

Film Regeneration and Preservation. Griffin Enterprises require Representative with knowledge of laboratories and renting. Write Box No. 4174, BRITISH KINEMATOGRAPH SOCIETY, 117, Piccadilly, W.1.

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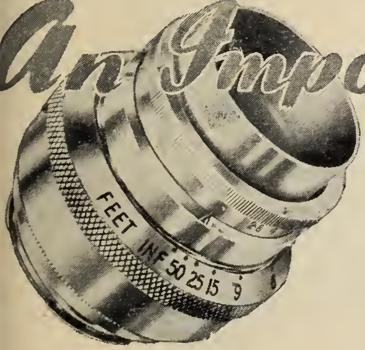

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

President : A. W. WATKINS, A.M.I.E.E., F.B.K.S., F.R.P.S.

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SEVENTEEN, No. 1 JULY, 1950

VISIT TO EALING STUDIOS

The third annual studio visit arranged by the B.K.S. Film Production Division took place on 13th May, 1950, when, by courtesy of Sir Michael Balcon, Hon. F.B.K.S., and Major Reginald Baker, a party of over 300 guests visited Ealing Studios.

An exhibition of studio equipment, arranged by the Incorporated Association of Kinematograph Manufacturers, was displayed in the Model Stage.

THE visitors assembled in the restaurant, from which two routes had been mapped out, parties starting alternately on each route.

Route No. 1 commenced at the foundry, from which the party went, by way of the paint shop, to the plasterers' shop. Here they were shown many different applications of plaster. The visitors were impressed by the gelatine moulds, in which intricate casts were made.

Photographers were particularly interested in the stills department, which was visited next. Here the well-equipped little studio was demonstrated by a member of the department. On view were stills from " The Blue Lamp " and other productions, also a representative selection of still cameras.

Next the carpenters' shop was viewed. Properties for the current productions " The Magnet " and " Cage of Gold " were being made. The properties shop, next door, created a great impression on the party ; a visitor remarked that it was the tidiest " junk shop " he had ever seen. Order was evident everywhere ; many of the properties used in past productions were seen.

The studio power house, where the G.E.C. generators were demonstrated, was the final building inspected on route 1.

Route 2 commenced at Stage 2. In here sets for " The Magnet " and " The Cage of Gold " had been erected. A Mitchell camera, fitted with a special tripod head carrying an extension frame for glass shots, was demonstrated.

In the adjoining stage some special effects apparatus was being worked, also fog-making apparatus and a most ingenious machine for producing bubbles. The bubble machine had been used to very good effect in the ballroom scenes from the current production " Dance Hall."

The new Sound Department was visited next. Ealing is the only studio in which it is possible to record either on RCA or British Acoustic—either photographically or magnetically ; selected takes recorded magnetically are transferred to photographic tracks. In small separate rooms, two RCA and two G.B.-Kalee recorder equipments were installed, together with G.B.-Kalee magnetic play-off equipment. In the adjoining sound garage, a 200-mil push-pull RCA equipment was mounted in a new sound truck. A patching room

Ealing Studios: the Plaster Shop

Two sets from "Cage of Gold"

contained power equipment and switchboards enabling one or more of the recording equipments to be connected to any of the stages or to the re-recording theatre above.

Upstairs, in the new re-recording theatre, an RCA re-recording console had been newly installed, which provided many refinements hitherto not available. Alongside the screen was an illuminated footage counter. In the projection room, Ross-RCA equipment was to be seen, comprising two LG-230P equipments, fitted with double-film attachments, and one LG-230R eight-channel re-recording and review equipment. Certain sound heads used with the LG-230R are modified to scan 200-mil recordings.

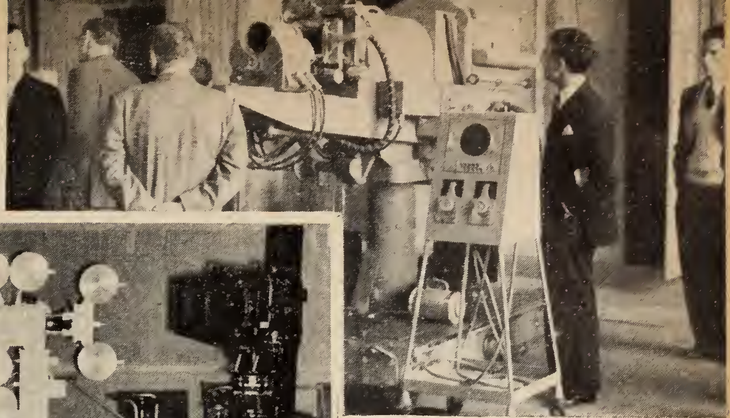
Next a visit was paid to the Editing Department, which comprised two negative cutting rooms and nine positive cutting rooms, all fitted with up-to-date Moviolas and Acmiolas.

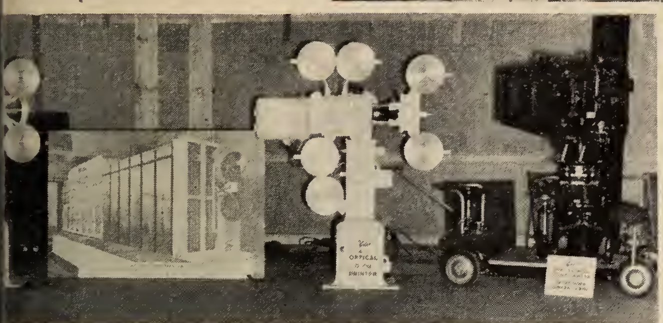
The parties then made their way to the model stage, where the joint K.M.A.-B.K.S. exhibition was housed. The Studio Manager, Mr. Baynham Honri, F.B.K.S., explained over the microphone that as a location unit was in the north of England, less of the Studio's own equipment was on view.

The Company was experimenting with radio communication for keeping in touch with location units in the London area, and a unit car was in touch with the studio by means of a Pye radio telephone, demonstrated by Alfred Imhof, Ltd. Messages were relayed to the assembled company over this channel, on a wavelength of two metres. These messages were from Sir Michael Balcon, Hon. F.B.K.S., and Major Reginald Baker, welcoming the British Kinematograph Society and its visitors to the Studio.

The President, Mr. A. W. Watkins, called upon two pioneers of the film industry, and Hon. Fellows of the Society, to propose and second a vote of

G.B.-Kalee Process Stereopticon
e described in a later issue of this
al) and the Vinten Exhibit.





Photos by Philip Jenkins and R. H. Cricks.

thanks to Ealing Studios for their hospitality. These were Captain Will Barker, who founded his own studio on the site of the present Ealing Studios, and Mr. Cecil Hepworth. Captain Barker, who recalled his early days in the studio, remarked upon the fact that the Government had as yet not taken over the censorship of films, and he urged that it should never be allowed to fall into their hands, but should remain the responsibility of those engaged in the film industry.

Among those who assisted in the arrangements and demonstrations, and to whom thanks were conveyed, were : Mr. Jack Ford, chief electrician ; Mr. Gordon Dines, chief lighting cameraman ; Mr. Reg. Gibbings, camera maintenance ; Mr. Jack Peck, electrical maintenance ; Mrs. K. Browne, cutting room manageress ; Mr. Stephen Dalby, chief sound engineer ; Mr. Norman King, sound maintenance engineer ; Mr. A. Bradburn, sound mixer ; Mr. F. Frankham, stills laboratory ; Mr. George Speller, construction manager ; Mr. A. Minnell, chief projectionist ; Mr. F. Peters, projectionist in charge of new recording theatre ; Mr. Don Dear, process projectionist ; Mr. D. Dickinson, process artist ; Mr. P. Teal, property department ; Mr. S. Pearson, head of special effects department ; and Mr. Roy Whybrow, special effects department.

Also present was Mr. Hal Mason, general manager of Ealing Studios.

EXHIBITION OF EQUIPMENT

An exhibition of equipment, arranged in co-operation with the Incorporated Association of Kinematograph Manufacturers, was held on the occasion of the British Kinematograph Society's visit to Ealing Studios on 13th May, 1950.

I — CAMERAS

N.G. Model G "Auto Kine" Camera*

FEATURES of the "Auto Kine" camera are its construction in duralumin, and the interchangeable 200 ft. film magazines which can be inserted or removed from the camera in a few seconds. The "Auto Kine" gives an exceedingly long film drive with one winding of its twin springs, of at least 170 feet. The winding of the mechanism is silent and can be operated whilst the camera is running. The camera runs at from 10 to 32 frames per second, and the design of the intermittent clamping gate entirely eliminates any possibility of film scratch or static.

The gate is fitted with laterally opposed register pins, ensuring complete steadiness, whilst the built-in tunnel finder gives a clear image, the right way up

* Newman & Sinclair, Ltd.

and right way round, and has parallax correction. Footage indicator and level are visible in the finder, and lenses of focal length 1 in. to 17 in. can be supplied, interchangeable on panel mounts.

Ground-glass and film gate focusing is given with straight look-through, operating silently from the rear of the camera, and giving in both instances an erect image.

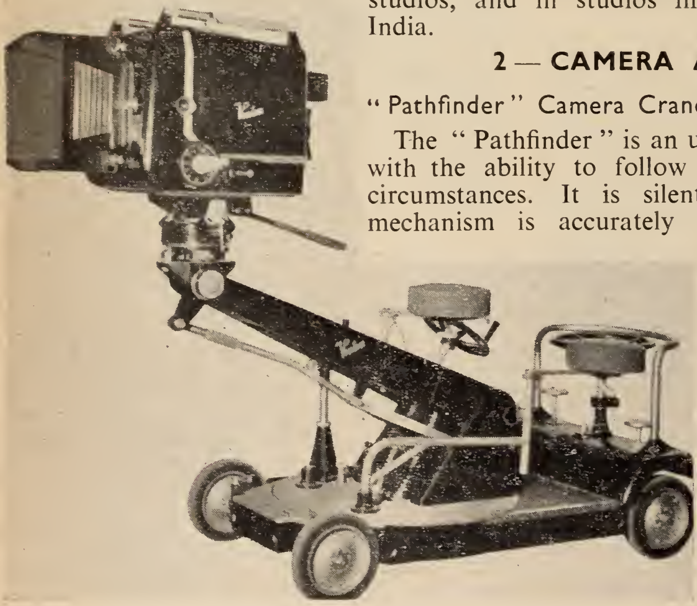
Net weight of the camera is 21½ lbs., and dimensions overall approximately 15½ ins. by 18 ins. by 10½ ins.

"Caméflex" 35 mm. Model B Portable Reflex Camera*

This camera, which has previously described,[1] was again on view.

"Everest" Studio Camera, Types I & II†

Visitors had a further opportunity of seeing the "Everest" Studio Camera [1, 2] which is now in use in many British studios, and in studios in Europe, Scandinavia and India.



2 — CAMERA ACCESSORIES

"Pathfinder" Camera Crane Truck†

The "Pathfinder" is an up-to-date camera mounting with the ability to follow action under almost any circumstances. It is silent in operation, and the mechanism is accurately counter-balanced, so that the whole equipment can be moved with a touch of the hand-wheels.

The "Pathfinder" is so designed that ample stability is assured, even at extreme horizontal angles. The camera head remains accurately level at any position, and a two-directional levelling device for quick levelling on uneven floors is provided.

The panoramic base mounting has a generous platform, which rotates with the camera, so that the assistant's seat, which is mounted on it, enables him to control the focusing during all follow shots. Rubber-tyred wheels are of sufficient width to avoid deflection when the camera weight is changed from one side to the other. The steering is so designed that the wheels can be turned through a complete right angle, and the forward wheels can be unlocked and turned through a right angle, so that the "Pathfinder" can be moved sideways into a difficult location. Special platforms can be supplied to suit any type of camera.

The rotary and tilting head is designed to carry all types of studio cameras.[3]

16 in. and 10 in. Geared Camera Heads‡

The 10 in. camera head is of similar design to the 16 in. head,[4] but proportionately smaller, and without the two-speed gear box and tilt wedge. It is

* W. F. Dormer, Ltd. † W. Vinten, Ltd. ‡ Ernest F. Moy, Ltd.

suitable for "wild" location and model work. The weight of the complete head is about 18 lbs.

The rolling tripod legs, available with these heads, incorporate many new improvements. They include solid moulded wheels of a new design, the legs have been strengthened at the top, and better grade materials have been chosen.

Three-Colour Filter Unit*

This unit is designed primarily for attachment to a Bell & Howell camera for taking succeeding blue, red and green frames in cartoon work. Since the drive is by means of a Maltese cross, the filter disc is stationary during the actual exposure. Filters can be fitted to suit all requirements. Mounting brackets to take camera and filter unit are available.

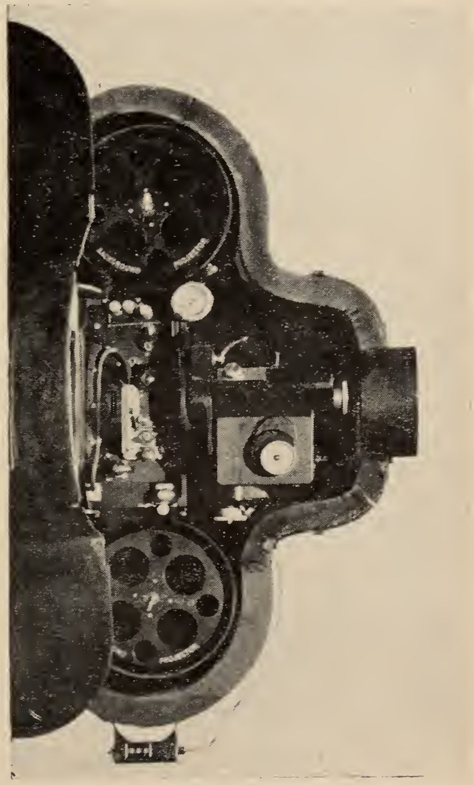
Camera Supports

The "Unipod"† is a ground support comprising two metal tubes extensible to convenient operating height with firm lock at any point of extension. The screw thread can be interchanged from the normal $\frac{3}{8}$ in. to $\frac{1}{4}$ in. Whitworth, and a protecting knob is provided for the thread, also a wrist sling. The maximum extended length is $64\frac{1}{2}$ ins., and the closed length 34 ins. The weight of the Unipod is $1\frac{1}{2}$ lbs.

The "Steady Sling"† comprises a wide web sling worn around the neck, with leather straps leading down to a section of leather which carries a bucket to take the camera supporting rod. The weight of the assembly is $1\frac{1}{2}$ lbs. The upper platform is of 2 in. diameter, again with reversible threads of $\frac{3}{8}$ in. and $\frac{1}{4}$ in. Whitworth.

"Cine-Viewer"†

The "Cine Viewer" is a hand-held device showing basically the sound frame field of a 25mm. lens. Additional interchangeable mattes for 35 mm., 50 mm. and 75 mm. are supplied with the standard viewer, whilst extra mattes for any other focal length can be supplied to order.



3 — SPECIAL EFFECTS EQUIPMENT

Process Projector‡

The film transport mechanism is of the eccentric drive type, the claw working through a curved guide at the bottom of the gate. Interlocking pins, similar in principle to those in 35 mm. cameras, are provided to ensure the maximum possible steadiness of projection. The shutter angle is approximately 150°, and thus will provide an adequate margin of safety for synchronization when used with a normal type of camera having a shutter of 175°. The gate is fitted

* Ernest F. Moy, Ltd.
† Newman & Sinclair, Ltd.
‡ GB.-Kalee, Ltd.

with a removable insert for easy cleaning and is air cooled; in addition, an air blast is played on to the film which effectively prevents condensation. The mechanism requires an input of approximately 1/3 h.p., at 1,440 r.p.m.

Independent motor drives are provided for both the feed spool box and take-up spool box and these drive through a special type of clutch. The double motor system is necessary since the projector may run in either the forward or reverse direction at will. The take-up motors are energised in advance of the starting of main motor, and thus take up any film slack in the spool boxes.

The condenser system is of the relay type, and consists of quartz spatter glass and No. 1 condenser, combined to form a water cell for cooling, incorporating also type ON20 heat-absorbing glass plate[5]. There are three more condenser elements in the system and also a dim-out iris. As an added safety precaution, a solid CO_2 fire extinguisher cylinder is fitted.

The focusing mount is arranged for instant acceptance of a range of objective lenses, and travels along accurately ground slides for roughly positioning the whole assembly in accordance with focal length lens in use. Fine and remotely controlled adjustment by " M " type motors of focus, lateral and vertical position of lens is incorporated. A remote control desk is provided for use at camera position, enabling the chief projectionist to " line-up " picture and focus, also, when multiple projectors are in use, to superimpose pictures.

The range of objectives at present supplied is :—3 ins., 4 ins., 5 ins., 6 ins. and 7 ins. All have an aperture of *f*/2.0.

The illuminant employed is the Type 1250A Mole-Richardson High Intensity Arc Lamp with three carbon trims, allowing for operation at 150, 225 and 300 amps.[6]

4 — LIGHTING EQUIPMENT

M.R. 1450 Arc ("The Brute")*

This lamp, on view for the second year,[7] continues to prove a great asset in motion picture production.

M.R. 461 Compact Source Flood-Light*

The new floodlight has been designed specifically to use the compact source mercury cadmium lamp[8]. Particular attention has been paid to the simplification of maintenance problems.

5 — SOUND RECORDING

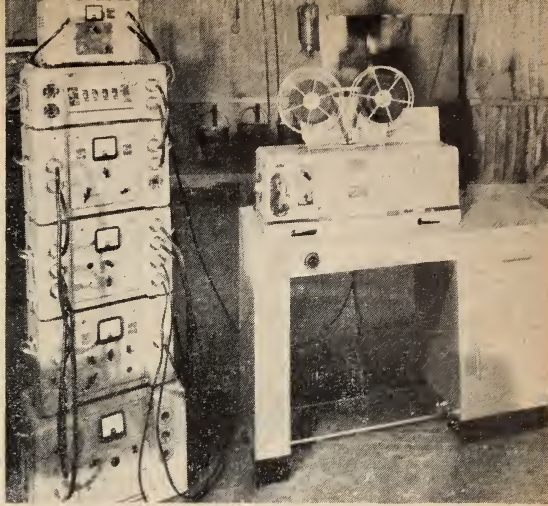
Gaumont-Kalee Combined Recording System†

This sound recording system has been designed to provide an extremely lightweight portable single film sound recording equipment. The recording amplifier unit, whose total weight is approximately 15 lbs., uses miniature battery type valves, and has two inputs with separate mixer controls and separate input circuit 2-position attenuators.

As one of the main objects of the design is simplicity and lightness, no noise reduction is provided; instead, high frequency pre-emphasis is used so that when reproduced with a complementary equaliser, a very good signal-to-noise ratio is obtained. The overall frequency characteristic of the system, including negative and print, is flat up to over 7,000 c/s.

High quality moving coil monitor phones are provided, intercommunication signals being mixed with the monitor signals. The battery pack provides sufficient capacity for shooting ten to fiteen thousand feet of film. Two high sensitivity moving coil microphones are provided as standard equipment, and a high quality lightweight ribbon microphone, as well as a special version of the well-known type 493 Cardioid microphone, will be available as extras.

* Mole-Richardson (England), Ltd. † G.B.-Kalee, Ltd.



Newall Camera with Gaumont-Kalee Recording Head

"Ferrosonic" Magnetic Recording Channel

The Gaumont-Kalee combined camera is an adaptation of the standard Newall 35 mm. camera[1]; the soundhead unit is attached to the rear of the camera body and may, if desired, be removed, leaving the camera quite standard. The mechanism of the soundhead is very simple and robust, the mechanical filter consisting of a flanged sound drum attached to a solid fly-wheel and a pair of spring connected jockey arms. The optical unit produces a variable density soundtrack and is precisely located relative to the sound drum so as to ensure correct positioning of the soundtrack. The recording lamp is rated at 6 volts 1 amp. A focusing microscope is provided and is arranged to fit inside the sound drum to view the image.

The galvanometer resonant frequency is between 7,000 and 8,000 c/s. The run-up time of the soundhead is approximately 2 seconds and the flutter content of the recording is less than .12% and wow less than .07%.

"Ferrosonic" Magnetic Recording and Reproducing Equipment*

The first type of Ferrosonic magnetic equipment[9] was based on the well-known "follower-head" type of re-recording photographic apparatus, whilst the second type of Ferrosonic magnetic equipment has been based on the equally well-known photographic sound recording camera.

The former is intended more particularly for stationary use in the studio, whilst the latter is suitable for studio use and, in addition, for location work as it can be easily transported in a truck together with its associated amplifier stack and ancillary equipment.

Normal 35 mm. perforated magnetic film is used at normal film speed, thereby enabling perfect synchronisation to be achieved with a complementary picture film or with other sound records.

The recording and playback takes place on the flywheel drum, so that the best possible conditions for constant film speed are obtained, resulting in a flutter content of less than 0.15 per cent. and a degree of "wow" of approximately 0.06 per cent.

Both types of Ferrosonic equipment are provided with a wiping head which erases any previously recorded signals from the film immediately prior to the recording taking place, whilst monitoring from the playback head takes place one-tenth of a second after the recording has been made.

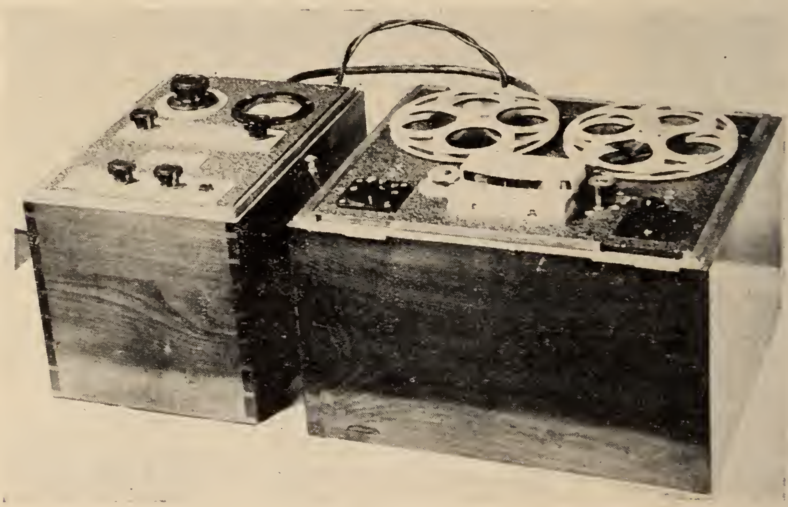
* GB.-Kalee, Ltd.

The supersonic supply unit contains special means for eliminating second harmonic distortion and, as a consequence, a very high signal-to-noise ratio is obtained without distortion, this ratio being approximately 60 db.

The input impedance of the equaliser is 500 ohms (balanced) and it requires an input level of 30 mV for full modulation of the sound track at 1,000 c/s. The recording amplifier is provided with means for compression, the compression-factors being 1:1.5, 1:2 and 1:6. The overall frequency response from 50 to 9,000 c/s is constant within ± 2 db.

Transportable Magnetic Recorder Model C*

This equipment is designed specially for film location work, using 0.25 in. magnetic tape running at 15 inches per second. The recording machine and amplifier take the form of two inter-connected units, and the power supply is from one 12v. accumulator.



Special features include : Supersonic bias and erase ; simultaneous monitoring from the tape ; frequency range equalised up to 10 kc/s. ; safety interlocking of recording controls ; separate motors for capstan drive, take up, and fast rewind ; and camera interlock system working on the control track principle.

Tape Recorder, Type BTR 1†

The tape recorder, Type BTR/1, is a high fidelity recording and replaying instrument, designed primarily for applications where quality, reliability and long duration playing are of the first importance.

Special features of this machine include a rubber-faced pressure roller which holds the tape in contact with the spindle of a synchronous motor, and drives the tape at a constant speed of 77 centimetres per second. Stroboscopic markings are provided on one of the guide pulleys to check the tape speed independently of the driving motor.

The three magnet heads are mounted in a single unit, which is easily detachable. Each head is individually screened, and has a life of at least 1,000 hours for highest fidelity.

* Leevers, Rich & Co., Ltd.

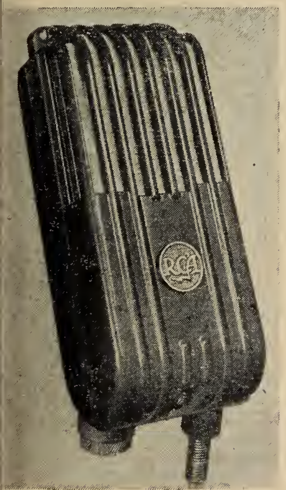
† E.M.I. Factories, Ltd. (Distributed by Films & Equipments, Ltd.).

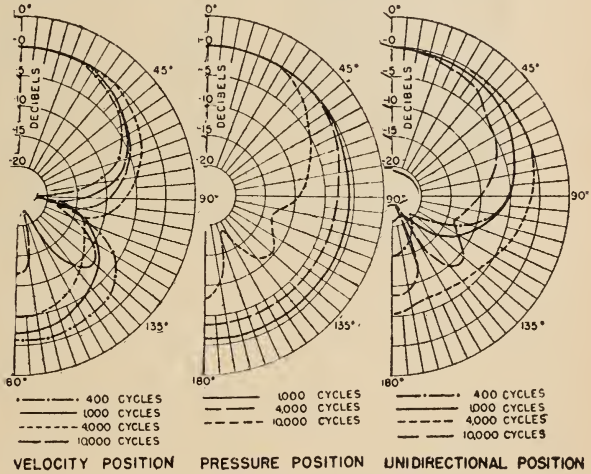
A device is provided for coupling a pair of instruments and automatically starting the second at the end of recording, or replaying, on the first instrument, thus giving a continuous performance. The input requirements of the recorder are 1 mW at 600 ohms impedance. The same applies to the outputs. The loudspeaker output at 2.5 ohms is 15 watts.

The speed variations are not greater than ± 0.5% over the whole length of tape, and the "wow" is not greater than ± 0.1%. Other points about this recorder include the fact that the signal/noise ratio is 60 db, and that there is an overall distortion of less than ½% at 1,000 c/s. The overall frequency response is flat within 2 db between 30 and 10,000 c/s.

"Varacoustic" Microphone*

This microphone is made in this country and is identical with the U.S.A. unit which has found a wide application in broadcast studios and for high quality pulic-baddress projects. A feature is the acoustic labyrinth, whereby the





microphone develops a uni-directional characteristic which is of special value for stage work in minimising feed-back. By adjusting an aperture coupled to the acoustic labyrinth the instrument can operate as a velocity microphone with the normal "figure-of-eight" characteristic or as a pressure microphone. Two intermediate positions producing cardioid characteristics are provided.

Disc Recorder Cutter Head. Type B.1†

This head is manufactured to B.B.C. design under licence. It is a moving iron head with an armature of a torque tube type ; it has a feed-back winding in addition to the main or driving winding and must be provided with up to 30 db. of negative feedback. Using a 16 micron sapphire cutting stylus ½ in. long and a high grade 13 inch lacquer disc, it will cut a Buchmann-Meyer pattern to within ±2 db. from 500 c/s to 12 Kc/s. The impedance is 15 ohms, and the weight 6 ozs.

* RCA Photophone, Ltd. † Ernest F. Moy, Ltd.

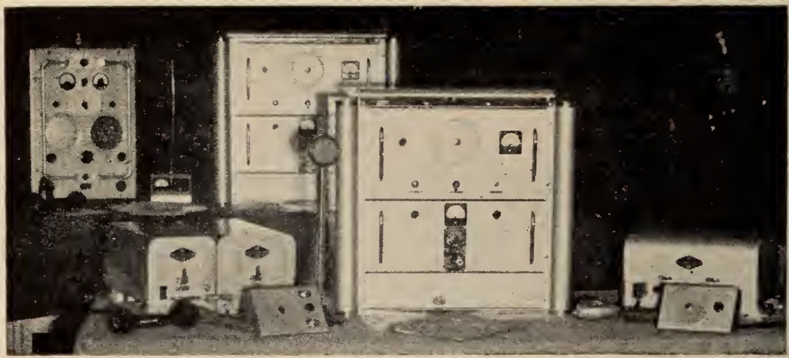
The cutter head, Type A, is a moving iron head, with an armature of the vibrating reed type, grease damped and designed for use with a cutter having an aluminium shank and a sapphire tip, with an overall length of ½ in.

6 — PRODUCTION EQUIPMENT

Radio Channel*

The fixed station V.H.F. equipment embodies the most modern developments of the well-tried V.H.F. communications technique. Combining high performance with simplicity of operation and built-in reliability, it will meet the most exacting needs of the film industry for communication with location units and similar purposes.

The transmitters and receivers are designed to operate on spot frequencies between 60-184 Mc/s, the frequency being stabilised by crystal control. They are suitable for use with an A.C. mains input supply of 100-150v. or 200-250v., 40-60 c/s.



The PTC 703/4 transmitting station is self-controlled and includes the fixed receiver and medium-power 12-15 watt transmitter housed in a pressed steel cabinet. Two alternative types of auxiliary control in addition to the usual local control can be provided. The extension control unit enables the station to be operated from another point in the same building, while the remote control unit can be connected to a telephone line to give control over distances of up to 15 miles.

Mobile Radio Telephone*

The equipment, which is in two-unit form, consists of a transmitter chassis and a receiver chassis. The transmitter chassis carries one rotary converter which is used in conjunction with the receiver rotary converter for "transmit" purposes. Each of the two units may be quickly and individually withdrawn from a common mounting cradle. The inner unit connections are made at the rear of the cradle via self-locating plugs and sockets.

Ross-RCA Studio Projector Equipment†

The studio projector assembly, comprising Ross type GC3 projector with studio modifications, with Streemlite arc and pedestal,[1] and fitted with RCA LM.9031 sound-head, is identical with the equipment installed in the studio projection theatres.

* Pye Telecommunications, Ltd. (Distributed by Alfred Imhof, Ltd.)
† Barnet-Ensign-Ross, Ltd.

7 — TEST INSTRUMENTS

"Avo" Test Meters*

Among a wide range of "Avo" electrical and electronic test equipment, attention was particularly directed to the Electronic Test Meter, an instrument based upon the principle of the valve voltometer.

The instrument has a bridge circuit, using a 6SN7 valve, and is capable of working up to 10,000v. D.C. For A.C. measurements, a detachable probe containing a small diode rectifier is provided, which can be used at any reasonable distance from the instrument, being connected thereto by means of a screened cable. This probe enables low-frequency signals to be measured without the introduction of losses which would normally occur in test leads at these frequencies, whilst at the other end of the scale, frequencies up to 200 Mc/s can be metered at a maximum voltage of 250v. The instrument has a high input impedance, which is of particular assistance when the lower ranges are in use.

16 mm. Service Test Films†

A new range of 16 mm. test films, suitable for use by projectionists and maintenance engineers, includes both sound track and picture image tests, made to a high degree of accuracy.

The range of these films will be fully described in a later issue. Most types of these films are available in lengths of 50 feet for normal use, or in 10 feet lengths for forming into loops.

In the Exhibition, a one-minute loop containing sample lengths of each film was run continuously through the projector, using a " Sound Services " drum film loop absorber, the image being shown on the screen while sound output was heard at low volume over a normal loud-speaker. A simultaneous picture of the waveform was shown on a cathode ray tube, which was connected across the projector output.

8 — EDITING EQUIPMENT

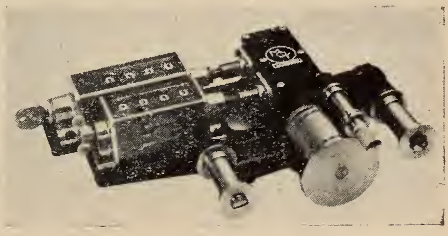
Track Reader, Model E†

Since first introduced the Track Reader has been adopted as a standard cutting room accessory by many firms.[10] A new model which has been added to the range includes a re-designed sound gate.

35 mm. Film Measurer with Accumulator‡

This unit was designed primarily for use in the stock manufacturing field, but is readily adaptable for other uses. The accumulating counter is key reset, and totals to 10,000 ft. Both counters are easily removable from the gear-box without disturbing the gears.

The 16 mm. Film Measurer is similar in design to the 35 mm. model, but without the accumulator. The single-sided sprocket is reversible endways on the spindle.



* Automatic Coil Winder & Electrical Equipment, Co., Ltd.
† Leevers, Rich & Co., Ltd.
‡ Ernest F. Moy, Ltd.

35 mm. Magnetic Jointer*

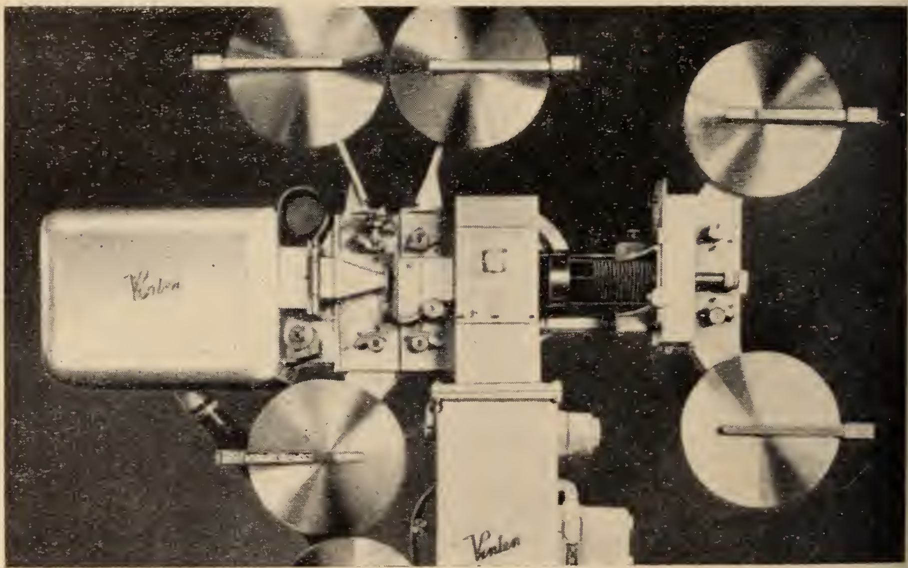
This unit is ideal for use in dark-room conditions. A bent-up tinned iron clip having three prongs on each side is held in place by a magnet in the punch end. The two ends of the film are held in the base and trimmed by the knife which is incorporated. On depressing the punch head on to the film the prongs of the clips are forced through the film and bent over. A 16 mm. model is also available.

9 — LABORATORY EQUIPMENT

16 mm. Optical Colour Printer†

This 16 mm. Optical Colour Printer has been developed to enable the user to produce colour prints to either the S.M.P.E. standard or the D.I.N. standard from 16 mm. negatives or reversal positives. At the same time a special method of colour balancing has been incorporated, giving an almost unlimited range of correction, with each variation accurately reproducible at will.

Advantage has been taken of the inherent characteristic of optical printers of increasing the contrast in the print. The negative or " projection " head is fitted with a gate capable of accepting two films and maintaining accurate



registration. This enables neutral masks first to be contact printed from the original, then projected in contact with the original as a contrast control mask. In this way contrast may be increased or decreased as required.

Incorporated in the optical system is a removable prism. Its purpose is to enable prints to be made with their images reversed from left to right. This feature allows standard prints to be made from both negative and reversal positives.

The optical system, on which patent rights have been applied for, incorporates a new form of printer light control. By means of the system employed, print density and colour balance are controlled simultaneously and automatically by a single paper control band. The band, previously punched to suit the requirements of the particular negative, consists of a 70 mm. wide

* Ernest F. Moy, Ltd. † W. Vinten, Ltd.

opaque black strip, perforated with standard B.S.I. perforations along each edge. The light source is a 500 watt projection type incandescent lamp, the light from which is evenly distributed over a square aperture plate. The aperture plate is divided into four equal parts, behind three of which are placed primary colour filters. The fourth aperture is white light. By using a suitable optical arrangement, the rays from the four apertures are made to superimpose at the negative plane, the resulting light being " white."

To balance a negative, more or less of any one of the primary colours is required, and is obtained by a suitable aperture punched into the control band, acting as an iris diaphragm. As twenty-two different value apertures can be punched opposite all three colour filters, a considerable range of control is obtained. The fourth aperture has a tungsten-to-daylight filter, and forms the main printing light. This aperture is also variable in twenty-two values, and is used for controlling print density. As the white-light aperture transmits approximately equal quantities of the three primary colours, variations in value cause only corresponding variations in density, and do not alter the balance of the resultant print.

The intermittent motion on the projection head is similar to a camera motion. It has two claws and two register pins. They are situated as close to the gate aperture as possible, the upper register pin being actually on the bottom mask line. Loss of registration, due to film shrinkage, is thus reduced to a minimum.

To ensure maximum control over the negative and the colour mask, one claw and one register pin are full fitting, whilst the other two fit vertically only. The printing head is fitted with double claws and a pressure pad gate, with provision for accurate framing and vertical and horizontal adjustments. A focusing and viewing magnifier is permanently attached, but easily swung away when not required.

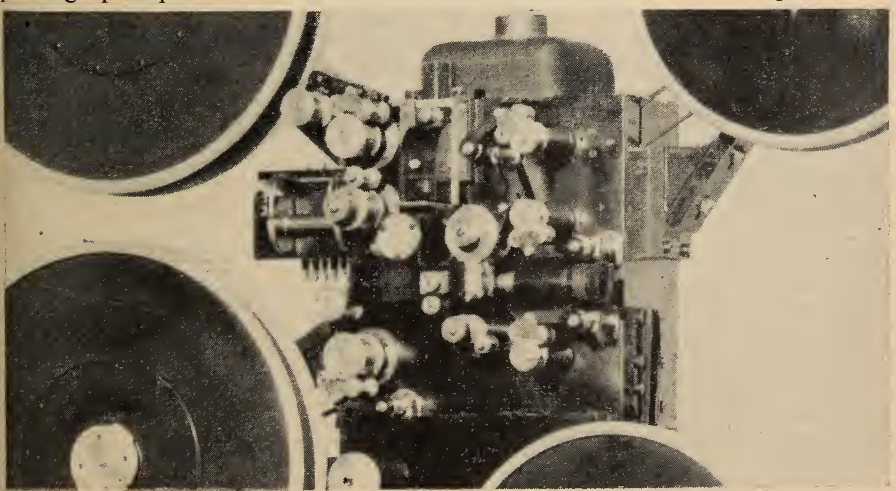
One-thousand-foot spools are fitted for the negative, print and colour mask.

The control band is operated by a micro-switch, actuated by small notches cut between the perforations in the negative.

To meet various conditions, a range of printing speeds is provided from about six feet to about eighteen feet per minute.

35 mm./16 mm. Sound Reduction Printer*

In place of the anamorphotic optical system customarily employed in the photographic production of 16 mm. sound tracks from 35 mm. originals, this



* W. Vinten, Ltd,

machine employs a beam-splitter system using only spherical lenses, and producing two exact replicas of the 35 mm. track, side by side on the 16 mm. film. The double track provides additional gain in the print.

The two spherical lenses have the highest quality definition, and, with fine-grain 16 mm. stock, a much extended frequency range can be accurately printed on to the 16 mm. film.

The layout comprises a 35 mm. take-off reel, and a 35 mm. gate with precision sprocket to control the negative in the gate. This sprocket is coupled to a rotary stabiliser. The film is also governed by a hold-back sprocket, and taken up on the take-up reel. On the 16 mm. side the film passes over a drum on the same shaft as the 35 mm. sprocket, so that the two films are mechanically related one to the other. The image from the 35 mm. film passes through two fully corrected lenses, in close association with each other. Each lens is matched for focus, and so set for position that two identical tracks are printed on the 16 mm. film from the single track on the negative.

The machine is capable of printing 60 ft. of 16 mm. film per minute, fine-grain stock being recommended.

The light change is a pre-set hand control with indicator operating an iris.

10 — SUNDRY EQUIPMENT

Talking Clock*

This prototype machine, designed and built in collaboration with the Dictaphone Co., Ltd., consists of a cabinet type 35 mm. play-off head, fitted with special control mechanism governed by impulses from a master clock. At every half-minute, an impulse from the clock starts a sequence of operations as follows :—

The exciter lamp is switched on, hold-back and take-up motors energised, drive motor relay closed and held closed by a timing cam which allows exactly 16 frames of the film carrying the sound-track to pass ; the closing down sequence is controlled by the motion of this cam, ensuring that the machine returns to quiescent condition exactly at the end of each time announcement.

The master recording is on 35 mm. non-flam. stock, at a linear speed of 6 ins. per sec. Dual track is employed, the announcements for 0 to 12 hours being recorded in one direction, and from 13 to 24 hours in the reverse direction, avoiding all rewinding operations and enabling the machine to operate automatically for long periods without attention.

* Leevers, Rich & Co., Ltd.

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2. *J. Brit. Kine Soc.*, **9**, No. 4, p. 145.
3. *Brit. Kine.*, **14**, No. 6, p. 181.
4. *Brit. Kine.*, **11**, No. 4, p. 125.
5. *Brit. Kine.*, **16**, No. 2, p. 38.
6. *Brit. Kine.*, **11**, No. 6, p. 188.
7. *Brit. Kine.*, **14**, No. 6, p. 183.
8. *Brit. Kine.*, **16**, No. 3, p. 93.
9. *Brit. Kine.*, **14**, No. 6, p. 188 ; **15**, No. 2, p. 37.
10. *Brit. Kine.*, **14**, No. 6, p. 191.

LIST OF EXHIBITORS

AUTOMATIC COIL WINDER & ELECTRICAL CO., Ltd., Winder House, Douglas Street, S.W.1
BARNET ENSIGN ROSS, Ltd., 235 Regent Street, W.1
W. F. DORMER, Ltd., 14 Edgeworth Road, N.W.4
FILMS & EQUIPMENTS, Ltd., 138 Wardour Street, W.1
G.B.-KALEE, Ltd., 37-41 Mortimer Street, W.1
ALFRED IMHOF, Ltd., 112-116 New Oxford Street, W.C.1
LEEVERS RICH & CO. Ltd., 80 Wardour Street, W.1
MOLE-RICHARDSON (ENGLAND), Ltd., Chase Road, N.W.10
ERNEST F. MOY, Ltd., 134 Bayham Street, N.W.1
NEWMAN & SINCLAIR, Ltd., 2 Salisbury Road, N.19
RCA PHOTOPHONE, Ltd., 36 Woodstock Grove, W.12
W. VINTEN, Ltd., North Circular Road, N.W.2

Sixth Newman Memorial Lecture

MEASUREMENT OF ACOUSTICS IN BUILDINGS

Dr. W. Tak*

Read to a joint meeting of the Royal Photographic Society and the British Kinematograph Society on 1st February, 1950

THE most complex request that can be made of an acoustician is to explain the nature of sound propagation in an auditorium. In conception the mathematical problem is difficult, and in detail it admits of only approximate solutions.

Equally complex is an understanding of the psycho-physical aspects of acoustics. Not only are the processes of hearing involved, but also habits of listening and the fact that musical compositions are intended to sound well in particular spaces, which are usually highly reverberant auditoria. These and other factors influence in a major way a listener's evaluation of an auditorium or studio as good or bad. However, not until all the significant physical variables are understood and controlled shall we be able to say that one design of studio or auditorium is superior to another.

I — METHOD OF DECAY OF SOUND

One parameter which has been used extensively in the design of enclosures is the reverberation time, defined as that length of time required for a sound to decay 60 db[1]. Audience opinions regarding values of reverberation time that are satisfactory in various rooms have served as helpful guides to good aud - torium design. There is some question, however, whether these criteria are strictly applicable to modern auditoria and studios, because of differences in shape between the old-fashioned rooms and rooms of modern design.

Many other quantities may be measured in an enclosure. These include fluctuations of sound during decay ; variation of sound pressure with position in the rooms ; magnitude of fluctuations in intensity as the frequency of a sound source varies.[2] ; the ratio of direct to reverberant sound ; modification of wave shape during transmission from one point in the room to another. Many of these types of measurements are not well developed. However, each may give some useful information about the performance of the enclosure. Our discussion is concerned with the measurement of reverberation time, because it is probably the most important variable, and because a long history of development is associated with it. Before describing a particular technique for measuring the reverberation let us examine the nature of it.

The phenomenon of reverberation has a great influence not only on the intensity of the sound, but also on the intelligibility of speech and the quality of music. It is not only a question of the length of time during which the reverberation lasts, but just as much of the variation of the intensity as a function of time—the character of the reverberation. This character is not, however, a property of the room in question only, but it is also determined by the nature and the position of the source of sound and the position of the observer.

Acoustic Characteristics of Auditoria

The study of the vibrations of the air in closed spaces has shown that such a space possesses a series of characteristic frequencies, each of which corresponds to a definite mode of vibration of that space.

* Philips Gloeilampenfabrieken, Eindhoven.

To begin with the consideration of a simple case, let us imagine a source of sound situated between two opposite plane walls of a rectangular room. The source emits a plane sound wave towards the front and rear, with a wave front parallel to the walls mentioned. A system of stationary waves will then occur between these walls. These waves will be strongly developed when the source emits a single frequency such that the distance between the walls is a multiple of a half wave-length.

These single frequencies form a series of characteristic frequencies. One can characterise these frequencies by the formula :

$$\lambda = \frac{2a}{p}\,; \quad \begin{array}{l} a = \text{distance between walls} \\ \lambda = \text{wave length} \\ p = 1, 2, 3 \ldots . \end{array}$$

In Figure 1 modes of vibration of the air are represented for $p = 1, 2, 3$ and 4. The walls are here assumed to be hard so that they reflect the sound almost completely.

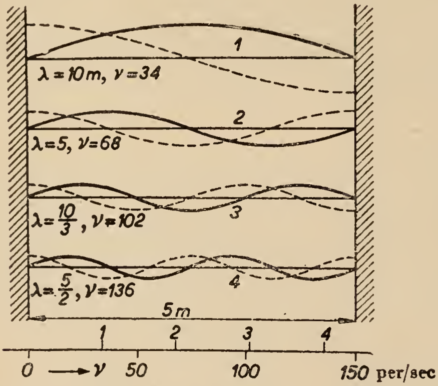

Fig. 1. Characteristic Frequencies of a Room.

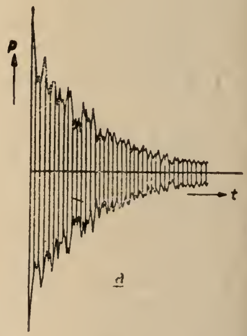

Fig 3. Decay of Sound, showing Interference Beats.

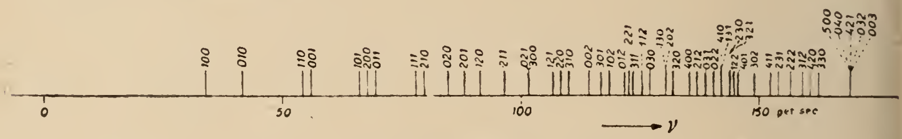

Fig. 2. Frequency Spectrum of a Room.

Actually the frequency spectrum in a rectangular room is more complicated : in the first place because there are three pairs of opposite walls, each with its own distance apart, and further because plane waves also occur which are not propagated parallel to one of the walls. The general formula for all these frequencies is :

$$\nu = \frac{c}{2}\sqrt{\frac{p^2}{a^2}+\frac{q^2}{b^2}+\frac{r^2}{h^2}}\,; \quad p, q, r = 1, 2, 3 \ldots \quad a = \text{length} \quad b = \text{width} \quad h = \text{height}$$

In Fig. 2 the frequency spectrum is given as an example for a room for which the length is 5 m., the width is 4 m., and the height is 3 m. It may be seen from this figure that the number of vibrations in a given frequency interval increases rapidly with increasing frequency.

Summation of Characteristic Frequencies

What happens when the source of sound is now switched off ? While previously at every point in the room there was a vibration with the frequency or frequencies of the source, we now observe a motion which can be conceived as a superposition of a number of characteristic vibrations, whereby those characteristic vibrations whose frequency differs little from the frequencies present in the source contribute primarily to the sound image.

Due to the absorption always present these vibrations will be damped, so that the reverberation may therefore be conceived as the sum of a number of damped characteristic frequencies. Let us now assume that in the closed space only one of the characteristic vibrations is active. At every point in the space, pressure and velocity are sinusoidal functions of the time. The sound energy, consisting of a potential part which is proportional to the square of the pressure, and a kinetic part proportional to the square of the velocity, is a periodic function of the time, which also depends upon the position of the observer.

If there is no damping the energy per unit volume (E), averaged over the space, is constant. If there is slight damping the total energy ($E.V$) decreases with the time according to the formula :

$$\frac{d\,(\overline{E}.V)}{dt} = -\frac{c\,\overline{E}A}{4} \text{ so that } \overline{E} = \overline{E}_o\, e^{-kt} \text{ where } k = \frac{cA}{4V}$$

V = Volume A = Absorption

E_o = Average energy per unit of volume at the moment $t = 0$

The Effect of Damping

The sound energy thus decreases according to an exponential law. In the presence of damping the sound pressure at every point in the room will be an exponential function of the time, so that :

$$\overline{p} = \overline{p}_o\, e^{-\frac{kt}{2}t} \sin 2\pi\, \nu_e\, t$$

The absolute value of the sound pressure may also be considered and averaged over a small number of periods. The average sound pressure p thus obtained also varies according to an exponential function of time:

$$\overline{p} = \overline{p}_o\, e^{-\frac{k}{2}t}$$

If there is more than one characteristic vibration active, each of them individually will die out exponentially. Since, however, the frequencies differ, these vibrations will cause beats by interference, so that the pressure will exhibit fluctuations. When a single tone is emitted in a room by means of a loudspeaker, upon interruption of the sound the greater the difference between the frequencies the smaller will be the amplitude of the excited characteristic vibrations, and thus only those characteristic frequencies will be noticeably active whose frequencies differ only slightly from the given frequencies.

Distribution of Absorbent Surfaces

In a room in which the absorbent materials are distributed uniformly over the surfaces, the damping constants of these characteristic vibrations can in general be reckoned equal to each other, because while the absorption coefficient depends upon the frequency, in a narrow frequency region it varies only slightly The interference picture will now be quite simple, and the amplitude modulation which occurs as a result of the interference will be clearly observable.

If the tone emitted by the loudspeaker is replaced by a more composite sound the interference picture will exhibit a different character, because a larger number of characteristic vibrations are then excited whose beats partially compensate each other, whereby the fluctuations, while more numerous, are less pronounced. The damping constants can now vary more widely. This will in general have little effect on the variation in the intensity as long as the sound emitted does not cover a very extensive part of the spectrum. If, however, the latter is the case and the wall absorbs, for example, only the low frequencies, then due to the rapid dying out of the low excited frequencies the room will have a shrill sound. If, on the other hand, absorption in the high frequencies is predominant, the room will have a hollow sound.

The situation is different when the absorbent materials are distributed very irregularly over the surface, for instance, in the case of a room with hard walls, whose floor is covered with a soft carpet. Here the vibrations between the hard walls will be much less damped than those between floor and ceiling. In such a room characteristic frequencies with very different damping will occur at the same time. In the variation of the pressure with the time, apart from the fluctuations, a superposition of different exponential functions can be recognized, because the strongly damped characteristic vibrations first die out, and only later the weakly damped ones.

Communicating Enclosures

A similar situation is encountered when a strongly absorbent room is connected by an opening with a room with slight damping, *e.g.*, a heavily damped room which is connected by an open door with a hard corridor. In that case

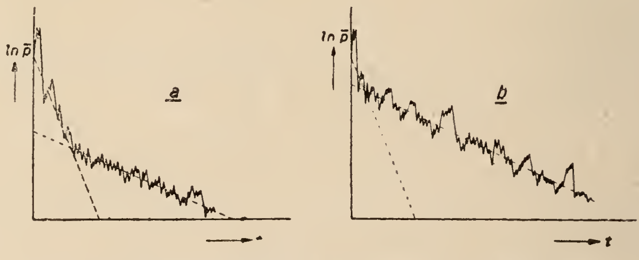

Fig. 4. Coupling between a Hard Room and a Damped Room.
(a) Observer in Damped Room. (b) in Hard Room.

it is advisable to consider the characteristic vibrations of each room separately. The characteristic frequencies will be slightly affected by the opening, which acts as a coupling, but they will only be altered inasmuch as those of the hard room penetrate slightly into the soft room and *vice versa.* In this case also in the combined room, characteristic vibrations with practically the same frequency but with very different damping will exist at one and the same time.

If the source of sound is situated in the room, the corridor will resonate faintly. An observer in the room hears chiefly the strongly damped characteristic frequencies of the room, followed by a faint more lasting reverberation of the corridor. An observer in the hard room, however, will notice chiefly the slowly dying sound in that room, while the quickly damped sound of the soft room which initially reaches his ear will quickly escape his attention.

Average Reverberation Time

We have seen that in the simplest case the average pressure varies as an exponential function of the time :

$$\bar{p} = \bar{p}_0 \, e^{-\frac{k}{2}t}$$

If we now define the reverberation time t_{60} as that during which the intensity decreases by a factor 10^6 (60 db.) (and thus the pressure by a factor 10^3), we find for this time t_{60} :

$$10^{-3} = e^{-k't_{60}} \qquad t_{60} = 2{\cdot}3\,\frac{3}{k'} = \frac{13{\cdot}8}{k}$$

$$\text{or, since } k = \frac{cA}{4V},\ t_{60} = 0.16\,\frac{V}{A}$$

V in m^3 A in m^2 of open window

In the case of an exponential drop the reverberation time measured is a parameter which completely determines the character of the reverberation.

In more complicated cases, for example when strong fluctuations are superposed on the exponential variation, there is, of course, no simple relation between the reverberation time and the character of the curve. In that case it is obvious that an average exponential curve can be drawn, disregarding the fluctuations, and a value of t_{60} can be found. This quantity is called the average reverberation time. It is true that the phenomenon is not thereby completely characterised, because the fluctuations have been disregarded, but it gives nevertheless the general character of the reverberation. If the reverberation consists of the superposition of different exponential functions each with its own constant k, perhaps combined with fluctuations, the obvious method is first to replace the curve by an average curve without fluctuations, and to analyse that curve into its purely exponential components. If one then determines t_{60} for the separate components one obtains a number of reverberation times which together to some extent fix the character of the reverberation.

2 — MEASUREMENT OF REVERBERATION

There are various experimental methods of investigating the reverberation. The oldest is that of Sabine, by which only the reverberation time is determined. For that purpose the time was measured which elapsed between the moment at which the sound became inaudible. This method was later improved by the use of an entirely automatically working apparatus which determined electrically the time in which the intensity of the signal decreased by 60 db.

We have seen, however, that the reverberation time depends very much upon different factors, and that it may have a very capricious variation, so that the sole determination of the reverberation time cannot give in this way a picture of the true variation of intensity.

At the present time use is made of recording meters which have the advantage that the exact behaviour of the reverberation is recorded, making it possible to draw an average curve and to determine from it one or more average reverberation times. Moreover, from the curve obtained conclusions may be drawn about the acoustic properties of the room being studied. The principle of these recording meters is very simple. After being amplified, the voltage of the microphone is connected to the ends of a potentiometer which is then automatically regulated so that the voltage taken off remains constant. The mechanical regulator at the same time drives a stylus which records the position of the potentiometer contact on a roll of paper.[3]

Requirements of Reverberation Meter

The necessary high velocity of recording in connection with the unavoidable mechanical inertia, makes the whole mechanical part of this apparatus extremely delicate and difficult to transport. We have therefore developed a method which is not subject to these objections. This method has been named the method of exponential amplification. We will consider once again the case where the sound pressure varies purely exponentially so that :

$$p = p_0\, e^{-\frac{kt}{2}t} \sin 2\pi\, \delta t$$

When we observe this quantity by means of a microphone, an amplifier and an electron ray oscillograph, and when we arrange the apparatus in such a way that after the interruption of the source of sound the amplification increases according to an exponential function of the time e^{at}, then, when a is chosen equal to $k/2$, the influence of the damping will just be cancelled by that of the amplification. The result is a simple sine curve with a constant amplitude. When a is larger than $k/2$ or a is smaller than $k/2$, the amplitude respectively increases and decreases with the time.

It is clear that we can also apply this method to those cases where fluctuations are superimposed on the general exponential behaviour. The fluctuations are to be sure not then eliminated from the result, but with a suitable choice of a the average amplitude can be kept constant. The whole can be made visible by connecting the output voltage of the exponential amplifier to the vertical deflection plates of an electron ray oscillograph. By synchronization of the time base with the apparatus which regulates the switching on and off of the source of sound it is possible to project the image of the reverberation on the screen repeatedly.

Since the variation of the intensity in a given case with the same arrangement of microphone and source of sound is entirely reproducible a constant image appears on the screen. By varying a that arrangement can be found with which the image of the average has a constant amplitude. In that case $a = k/2$

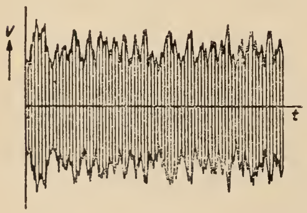

Fig. 5. Oscillogram produced when rate of increase of Amplifier Gain equals rate of Sound Decay.

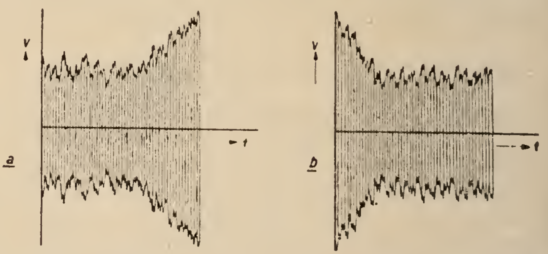

Fig. 6. Superimposition of two Decay Rates, measured at different Rates of Gain.

and from that the average reverberation time can be deduced. At the same time the character of reverberation can be studied. In some cases the reverberation consists of several terms with different values of $k/2$. From the oscillogram it may then be seen that at several values of a the amplitude can be made constant for a part of the image, from which the different reverberation times present can be simultaneously deduced.

Construction of Reverberation Meter

Fig. 7 shows diagrammatically the components comprising the reverberation meter and how these are interconnected.

The microphone, set up in the space where the reverberation time is to be measured, is connected to a cathode-ray oscillograph via a pre-amplifier and the exponential amplifier to be discussed below. As source of sound a loudspeaker is used, which is connected to a generator via an output amplifier and an impulse exciter, the latter serving to switch the loudspeaker on and off periodically so as to give a series of sound impulses. Each sound impulse has to be synchronized with the beginning of the exponential amplification and the beginning of the movement of the luminous spot across the screen of the oscillograph from left to right. As soon as the amplification has reached its final value it has to return as quickly as possible to its initial value and the spot from the right side of the screen to the left side to start a new cycle.

The operation is illustrated in Fig. 8, showing successively the sound intensity produced and the sound intensity received, the logarithm of the amplification g of the exponential amplifier, and the horizontal deflection x on the oscillograph, all as functions of the time t. When the ratio between the final value g_t of the amplification to the initial value g_o has been definitely adjusted so as to correspond to 60 db and the duration T of the cycle is so chosen that the amplitude y of the oscillogram remains constant, then T is the reverberation time t_{60} that is sought. Bearing in mind that the regulation of T practically means giving the right slope to the line $g = f(t)$ it is evident that the result is independent of both the duration of the impulses T and the time t' the sound takes to travel the shortest path from the loudspeaker to the microphone. If, for instance, t' is increased to t'' by setting up the microphone farther away from the loudspeaker, then the oscillogram will begin at t'' but the same cycle T will be found during which the amplitude remains constant. Only the interval Δt

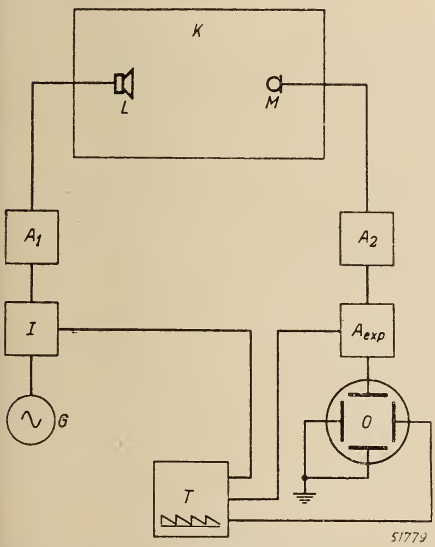

Fig. 7. Diagram of Reverberation Meter. G Tone Generator, I Impulse Generator, T Time Base, A_I Amplifier, L Loudspeaker, M Microphone, A_2 Amplifier, A_{exp} Exponential Amplifier, O Plates of Oscilloscope.

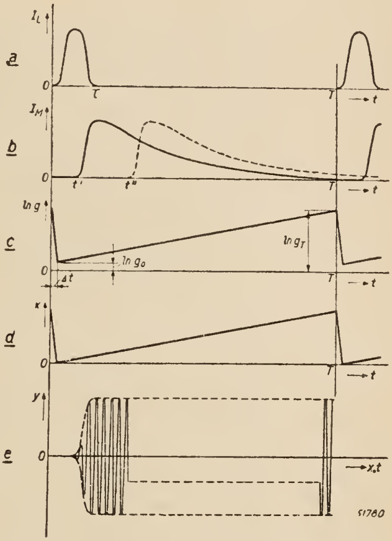

Fig. 8. Operation of Reverberation Meter. a Envelope of Sound Pulse, b Envelope of Sound received by Microphone, c Gain of Exponential Amplifier, d Horizontal Deflection of Oscilloscope, e Wave Form on Oscilloscope when $T = t_{60}$.

required by the amplifier to return from the final value to the initial value of amplification should be deducted from T, but this correction is so insignificant as to be negligible.

The aforementioned synchronisation between the various phenomena is obtained by controlling from one point the impulse exciter, the exponential amplifier, and the horizontal deflection on the oscillograph. The central control point is the generator of the linear time-base voltage.

We shall now consider in succession this time-base voltage generator, the exponential amplifier and the impulse exciter.

Time Base Voltage Generator

In a sense this consists of a condenser gradually charged via a resistor from a direct voltage source and rapidly discharging via a relay-valve, the charging and discharging alternating periodically.

If the resistor through which the charge flows were an ordinary resistor then the capacitor voltage V_c would rise exponentially with t, but by using a pentode as resistor and causing it to work in the range where the anode current is independent of the anode voltage a constant charging current is obtained, so that $V_c = I_0\ t/c$ `changes linearly with t.

The same applies for the voltage V_p on the pentode $= E—I_0 \times t/c_0$. The maximum amplitude of V_c is limited to a value which is a certain amount smaller than E. It depends in fact upon the striking voltage of the relay valve. With the aid of a variable direct voltage on the grid of the relay valve the striking voltage is so adjusted as to make the amplitude of V_c correspond to the voltage required to carry the luminous spot across the whole width of the screen of the oscillograph.

The period of relaxation oscillation of the system described must, as we have seen, be equal to the reverberation time of the space under investigation. This reverberation time may be anything between 0.1 second to a number of seconds. The frequency of the relaxation oscillation must therefore be variable. Its cycle consists mainly of the charging interval of the capacitor, which is charged all the quicker according as C_0 is smaller or I_0 is greater. In the practical construction of the apparatus these two quantities have been made adjustable, C_0 in coarse and fine stages, and I_0 continuously with the aid of the screen grid voltage of the pentode.

Before measuring is started the screen grid voltage is adjusted so that I_0 has a value fixed once for all. The actual measuring is effected by making the vertical amplitude on the oscillograph constant, which is done by regulating C_0 the reading of which is the required measurement.

Exponental Amplifier

In the exponential amplifier pentodes are employed whose anode current in a certain range is an exponential function of the control grid voltage. When a certain range of this voltage is traversed linearly with time then the anode current (and likewise the mutual conductance) changes with time according to an exponential law. The same applies for the amplification factor of an amplifier in which such pentodes are used. Pentodes possessing this property are, *e.g.*, those of the types EF 41.

Measurements taken in a push-pull amplifier with two stages equipped with these pentodes have shown that when the control grid voltage is changed simultaneously in both stages the limits of the range just mentioned correspond to values of the amplification lying about 50 db apart.

The definition of reverberation time is based upon a fall of 60 db in the sound level, which should be compensated by an equally large increase in the amplification, but this is neither necessary nor desirable. Starting from the highest practicable intensity of the sound impulses one finds in practice that after having been attenuated about 40 db the reverberation has already reached a level at which various interferences become troublesome. These interferences consist partly of the noise of the amplifier and partly of sounds having nothing to do with the measurement. For this reason it is not desirable that the amplification should increase by more than 40 db, and this is in fact sufficient since the time in which the reverberation decreases 40 db in intensity is correlated in a simple manner to the time t_{60}:

$$t_{40} = \tfrac{2}{3}\ t_{60}$$

On the other hand it is not desirable to let the reverberation drop much less than 40 db because then in a conversion to t_{60} the inevitable measuring errors would be increased by too large a factor. We therefore decided to work upon a drop of 40 db in the reverberation, and consequently an increase of 40 db in the amplification. With the abovementioned two-stage push-pull amplifier this increase of 40 db is obtained by causing the negative grid voltage to drop by about 32 volts. To ensure that the amplification starts and stops at the right moment the grid voltage variation is brought about by means of the time base voltage generator.

It should be added that the frequency characteristic of the amplifier is a horizontal straight line in the audible range of about 50-10,000 c/s.

Impulse Exciter

The impulse exciter is in fact an amplifying stage introduced between the tone generator and the final-stage amplifier, and biased in such a way as to be alternately either blocked or caused to act as an amplifier, so that the loud-speaker produces a series of sound impulses.

This varying bias is likewise drawn from the time-base voltage generator, so that the rhythm of the sound impulses corresponds to the frequency of the time base voltage. This time-base voltage is first subjected to a certain dis-

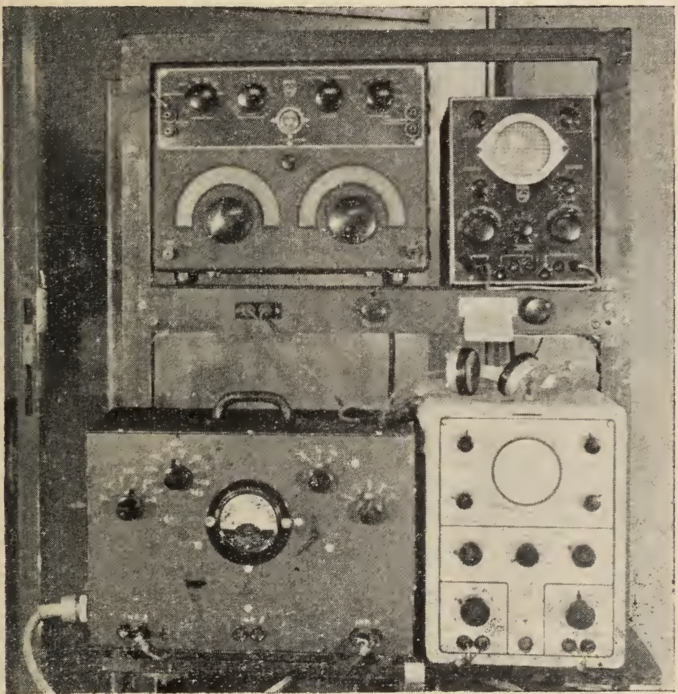

Fig. 9. Apparatus for Measuring Reverberation.

tortion so as to satisfy the requirements of being able to regulate the duration of each impulse within certain limits, and preferably without changing the maximum sound intensity. This requirement is made for the following reason. A long impulse (of the order of the reverberation time) is undesirable, because during that time no reverberation can be observed and the width of the oscillograph screen corresponding to t is therefore lost ; t must consequently be kept small with respect to the reverberation time. On the other hand very short impulses would not give sufficient volume of sound, particularly in large halls. The most favourable compromise must therefore be found.

Practical Construction of Apparatus

The arrangement given diagramatically in Fig 7 may consist partly of normal apparatus, the tone generator, the final stage amplifier, the oscillograph, the preamplifier and further the loudspeaker and the microphone. Except for the two last-mentioned components and the preamplifier, the others are mounted on a mobile rack which also carries a cabinet containing the time base voltage generator, the exponential amplifier and the impulse exciter. (Fig. 9).

A separate cabinet contains the apparatus required for supplying the various components with stabilized direct voltages. Finally there is an auxiliary oscillograph on which a Lissajous figure can be produced by the voltage from the tone generator and the AC mains. This makes it easy to adjust the tone frequency exactly to a multiple of the mains frequency, and if the latter may be regarded as constant then one is sure that the same frequency has been used when taking the various measurements, so that the results may be more comparable.

A measurement is carried out in the following way : When the apparatus described has been started up and the tone frequency given the desired value, the capacitance C_o in the time-base voltage generator is regulated so as to keep the amplitude of the oscillogram as nearly constant as possible. When this has been done the duration of the reverberation can be read from the position of the controls for regulation of C_o.

3 — ASSESSMENT OF RESULTS

Obviously when it comes to practical application matters will not be so simple as they have just been outlined above, considering that an enclosed

Fig. 10. Oscillograms with $T = 1.3$, 1.1 and 0.9 second.

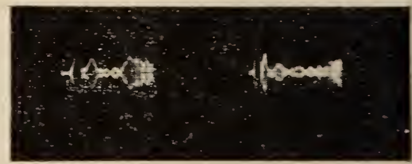

Fig. 11. Coupling between "soft" and "hard" Room.

space has a large number of characteristic vibrations all of which are more or less excited by the sound impulses, and beats will arise between those vibrations and will always show a number of peaks. It will be seldom that an adjustment can be found to give peaks of equal size, but after some experience there will be no doubt about what is the best adjustment. For instance Fig. 10 shows recordings taken under identical conditions with T values of 1.3, 1.1 and 0.9 second respectively, and there the best adjustment is $t = 1.1$ second.

Of course it is more difficult in cases where one has to do with two or more average reverberation times, as occurs for instance when a "soft" room (with short reverberation) is in communication via an open door with a "hard" corridor (long reverberation). Fig. 11 shows two recordings made in such a case.

Finally a description is given of an experiment confirming the fact that sound impulses excite a series of characteristic vibrations of the room in which they are produced, and that beats arise between those vibrations, as mentioned in the foregoing. The apparatus used in this experiment was the same as that previously described.

Plotting Mode of Sound Decay

First the impulse exciter was put out of action, so that the loudspeaker produced an uninterrupted note. Also the exponential amplifier was temporarily out of action ; a constant amplification was applied between the microphone and the oscillograph tube. This tube received no voltage for the horizontal deflection, so that the image consisted only of a small vertical line the length of which was proportional to the sound pressure at the microphone. This line was photographed on a continuously moving film, whilst the frequency of the tone generator was gradually changed. The result was a picture of the sound pressure (at the microphone) as a function of the frequency (Fig. 12). The frequency scale was fixed by interrupting the pick-up circuit every time a certain frequency was passed. Fig. 12 shows that in the room where the experiment was carried out and with a given arrangement of loudspeaker and microphone few pronounced characteristic frequencies occur in the range between about 1,020 and 1,065 c/s, but that they do decidedly occur between about 1,065 and 1,120 c/s.

What conclusions are to be drawn from this regarding the reverberation that will occur when sound impulses are produced in this room with different pitches within the frequency range traversed in this experiment and with different durations of the impulses ? Let us first give the tone a frequency equal to a characteristic frequency of the room, lying roughly midway between two adjacent characteristic frequencies, for example 1,072 c/s. It may then be expected that this characteristic frequency as well as the two adjacent ones (1,069 and 1,076 c/s) will be strongly excited, whilst more remote vibrations (*e.g.* 1,085 c/s) will be much less excited, and that beats will arise with a frequency that is the difference between the note frequency and that of the first-mentioned vibrations (3-4 c/s).

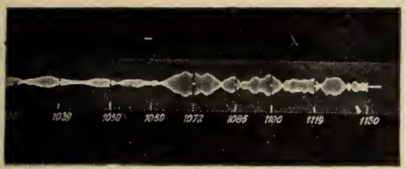

Fig. 12. Characteristic Vibrations of a Room.

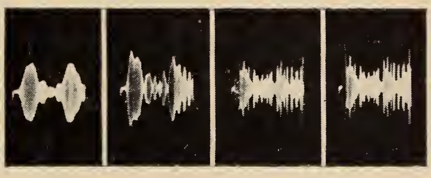

Fig. 13. Beat Frequencies excited by 1072 c/s.

Beat Frequencies

This is confirmed by Fig. 13, recorded with the whole of the measuring apparatus described in this article in action, thus including impulse exciter, exponential amplifier and time-base. Here we see a more or less sinusoidal pressure amplitude varying with time and showing exactly two cycles in the time-base period. In this experiment the time-base period was 0.54 second, so that the frequency of the amplitude variation was $2/0.54 = 3.7$ c/s, which corresponds well with the frequency differences between the pitch used (1,072 c/s) and the two adjacent characteristic frequencies. The phenomenon represented may therefore be ascribed to beats between these frequencies.

If we choose 1,060 c/s as tone frequency then, as may be seen from Fig. 12, the nearest pronounced characteristic frequencies are the same three as just mentioned (1,069, 1,072 and 1,076 c/s). In the oscillogram of the reverberation, Fig. 14, we now recognize—though less clearly—a frequency of about 14 c/s, which again corresponds, within the accuracy of measurement of the frequencies, to the difference between the pitch used and the adjacent characteristic frequencies. The same is the case with a tone of 1,086 c/s (Fig. 15).

One would expect excitation not only of the group around 1,072 c/s but also of the characteristic frequencies at 1,093 and 1,100 c/s, and therefore, in the image of the reverberation, beat frequencies of 7 and 17 c/s, among others. These two interferences are indeed to be recognized in Fig. 15.

Length of Pulse

Figs. 13, 14 and 15 have all been recorded with a fairly long duration of the ound impulses, 0.12 sec., so that each impulse covered more than 100 cycles.

The images obtained with shorter impulses are given in the same figures above *b*, *c* and *d* where the values of *t* were respectively 0.07, 0.035 and 0.02 sec. The shorter the duration of the impulses, the more complicated is the structure of the oscillograms, which points to a larger number of excited characteristic frequencies. This is not surprising considering that in the Fourier spectrum of the sound impulse more terms are involved according as the impulse is shorter. A change of the impulse duration can therefore contribute towards giving the oscillogram such a shape as to make it easier to find the right adjustment of the period *T*. This was in fact another reason why *t* was made variable.

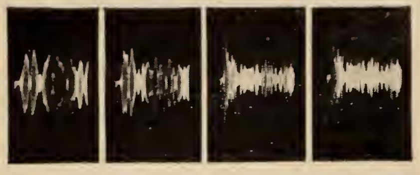

Fig 14. Beat Frequencies excited by 1060 c/s.

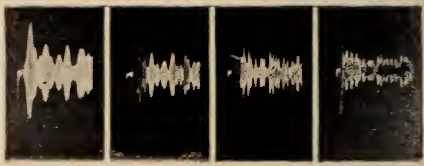

Fig. 15. Beat Frequencies excited by 1086 c/s.

REFERENCES

1. See also "The Measurement of Reverberation," by the present author. *Philips Tech. Rev.*, 1946, p. 82.

2. *Brit. Kine.*, **10**, No. 2, Mar., 1947, p. 72.

3. *Brit. Kine.*, **16**, No. 3, Mar., 1950, p. 76.

DISCUSSION

Mr. E. D. Swann : It seemed that the tone generator was generating a pure tone, and the pulse generator was in fact providing a modulation envelope. It would be a very complicated bit of mathematics to identify just what is the mathematical function of that envelope, and therefore to calculate by Fourier's analysis what are the frequencies generated.

The Author: In order to approximate the condition existing of speech or music, the frequency of the sound can be modulated, or else the sound can be made to consist of short impulses of a certain tone. Since I consider the latter to be the best imitation of speech, I have utilised sound impulses while carrying out my measurements.

The shape of the oscillogram depends only on the characteristic vibrations which are excited by the beats between these vibrations. The more complex the source, the more complicated this oscillogram. The recording apparatus, however, does not influence the shape. It requires a bit of mathematics indeed to identify exactly what happens. Under special circumstances, however, some calculations can be made.

Mr. D. Forrester: The source was a sound at a given frequency, which was modulated by the source which limited the exploration of that particular narrow band. Would it be a true picture in a source of a very complex sound?

The Author: When we give a very short impulse, a large spectrum is introduced and plenty of characteristic frequencies are excited. The same will occur when the sound source introduces a number of frequencies simultaneously. The picture on the screen of the oscillograph will be so complicated that generally speaking this will have no value for further exploration.

Mr. A. Watkins : Assume monaural listening to take the place of recording, at a standard frequency of 500 c/s, what would Dr. Tak consider an ideal reverberation time for (a) a room recording dialogue, (b) one for recording music?

The Author: In a room, speech will have a certain intelligibility if the ratio between the direct sound plus the useful part of the reverberant sound and the useless part of the reverberant sound has a certain value. It is my opinion that a ratio of a least 8db is necessary to have a good intelligibility. That means that the reverberation time for good intelligibility should in my opinion always be 0.8 second. For music, on the other hand, it is totally different. The best reverberation time depends upon the volume. A normal music hall should have a large volume, at least 40 metres in length, 14 metres high and 30 metres wide. For low frequencies we can have a long reverberation, but the time should not exceed 3 seconds. Upwards in the high frequencies, 2.5 to 2 seconds.

Mr. D. Forrester: Surely the period is also linked with the sound intensity?

The Author: No, there is no relationship between the sound intensity and the reverberation time. The reverberation period is independent of the power of the source.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

PRECISION LENS-TESTING AND COPYING CAMERA

H. W. La Rue, *J. Soc. Mot. Pic. Eng.*, October, 1949, p. 379.

The paper describes a rigid camera with accurate means of plate location which has been used for precision copy work and lens testing. A. H. A.

DIRECTIONAL MICROPHONE

Harry F. Olson and John Preston, *R.C.A. Rev.*, Sept., 1949, p. 339.

A new directional microphone is described, in which two cardioid units are mounted in such a way that they behave as a second order gradient microphone, having a directional pattern which is considerably narrower than the normal cardioid characteristic. The theoretical and practical performance of the microphone is described in detail. The application of the microphone to film or television sound work will involve considerable modification of pick-up technique. N. L.

MAGNETIC RECORDING IN MOTION PICTURE TECHNIQUES

J. G. Frayne and H. Wolfe, *J. Soc. Mot. Pic. Eng.*, Sept., 1949, p. 217.

Developments in magnetic recording are described, applied to Western Electric recording and reproducing systems. The recording head is accommodated in front of the flywheel roller on a damped supporting arm and contacts the magnetic coating at the recording drum. The reproducing head is mounted above the tight film loop between two rollers. The flutter content is 0.1 per cent. A multigap erasing head is used. The quality obtained is described as unsurpassed in any previously known recording system. O. K. K.

35 mm. AND 16 mm. SOUND-ON-FILM REPRODUCING CHARACTERISTIC

John K. Hilliard, *J. Soc. Mot. Pic. Eng.*, Oct., 1949, p. 389.

The factors governing normal 35 mm. recording and reproducing characteristics are reviewed, and the correct electrical characteristic for 16 mm. sound is described. In view of recent advances in 16 mm. work, a modified characteristic is recommended, giving wider frequency range. N. L.

THEATRE SITES

E. G. Faludi, *J. Soc. Mot. Pic. Eng.*, Oct., 1949, p. 396.

The paper deals with the appraisement of kinema sites by social, economic and physical factors, and proposes a technique by which a suitable site may be selected in most localities. H. L.

PORTABLE DEVICE FOR MEASURING RADIANT ENERGY AT THE PROJECTOR APERTURE

A. J. Hatch, Jnr., *J. Soc. Mot. Pic. Eng.*, Oct., 1949, p. 363.

A device for measuring energy values in the gate of a projector consists of a tube fitting into the lens mount, and a plate projecting into the gate aperture, having a hole .080 in. in diameter, radiation passing through which is focused by a lens upon either a thermocouple or a photometer. R. H. C.

STABILITY OF ARC CONTROL

R. H. Cricks, *Ideal Kinema*, Aug., 1949, p. 15, Sept., 1949, p. 19.

The characteristics of resistance, reactance, and resonance control of arc supplies are considered, from the point of view of ease of control and stability of light output. AUTHOR'S ABSTRACT.

NEW PORTABLE HIGH-INTENSITY ARC SPOTLIGHT

R. J. Ayling, *J. Soc. Mot. Pic. Eng.*, Oct., 1949, p. 408.

A spotlight for theatrical use, comprising an A.C. arc lamp with built-in transformer for use with a 110 volt supply. The light source is a 1 KW high intensity arc ; a mirror collects the light and illuminates an aperture which is imaged by a two-element variable focal length optical system to form a spot of variable size. Light output is 6,000 lumens at an intensity of 2,000 lumens/sq. ft, F. S. H.

ENGINEERING TECHNIQUES IN MOTION PICTURES AND TELEVISION
MOTION PICTURE LABORATORY PRACTICE FOR TELEVISION
TELEVISION FILM REQUIREMENTS
WILL FILM TAKE OVER THE TELEVISION COMMERCIAL ?

J. Soc. Mot. Pic. Eng., August, 1949.

These four articles are concerned with the special requirements of films, both 35 mm. and 16 mm., made for use in television transmitting stations. It has been pointed out that film picture and sound should exceed in general quality the capabilities of the television system : in other words, the bottleneck in presenting a film programme should lie in the television transmission and reception and not in the film recording. Following this general instruction the parameters of all the various film processes and dimensions are given.

T. M. C. L.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library

PERMANENT CONTROL OF SCREEN BRIGHTNESS

The Contróle Technique du Cinéma has prescribed a method of control of screen brightness, consisting of a photo-cell mounted at the edge of the screen, reading on a meter in the projection room. *Tech. Ciné.*, May, 1950.

U.S. NAVY 16 mm. PROJECTION SPECS.

The U.S. Navy has laid down requirements for 16 mm. projection, which include a picture brightness of 5 foot-lamberts on an 8 ft. screen, and a maximum permissible sound distortion of 3 per cent. on a 400 c/s test film. *Inter. Proj.*, June, 1950.

THE COUNCIL

Summary of meeting held on Wednesday, June 7, 1950

Present : Mr. A. W. Watkins (*President*), in the Chair, and Messrs. L. Knopp (*Vice-President*), H. S. Hind (*Hon. Treasurer*), Rex B. Hartley (*Hon. Secretary*), B. Honri, N. Leevers, R. E. Pulman, S. A. Stevens and I. D. Wratten.

In Attendance : Mr. R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. F. G. Gunn and W. M. Harcourt.

New Members.—The President extended a warm welcome to Mr. N. Leevers and Mr. S. A. Stevens on their first attendance.

Deputy Vice-President.—Mr. E. Oram was appointed to this office for the current year.

Sections.—Your Branches Committee was asked to give full consideration to the problems which exist in the provinces and to make recommendations to the Council.

Film Production Division Committee.—Your Committee reported that it had planned a series of papers for the 1950/51 session entitled " Production Economics and the Studio Technician." Five joint meetings with the A.C.T. had been arranged.—*Report received and adopted.*

The following resolution was moved :

> " The Film Production Division Committee consider it a matter of prime importance and are resolved to take all possible steps to assist the recovery of the British Film Production Industry through its lecture programme, by encouraging the free exchange of technical ideas and by any other means which may be agreed upon."—*Resolution put and carried.*

Theatre Division Committee.—Your Committee reported that its main consideration had been the 1950/51 lecture programme. A demonstration of large screen television and a paper on " Developments in Theatre Rear Projection " were planned for the first half of the session. An innovation would be the introduction of evening meetings as well as

Sunday morning meetings which, it was hoped, would better suit the convenience of many members.

Your Committee had appointed Major Bell to the Office of Deputy Chairman. He will thereby become Chairman of the Theatre Division Papers Committee.—*Report received and adopted.*

Sub-Standard Film Division Committee.—Your Committee reported that it had appointed Mr. D. Cantlay Divisional Representative on the Council, pending a formal election by the Division.

The programme of papers for the 1950/51 session, with one exception, was complete and had been approved by the Papers Committee.

A technical committee had been planned to operate under the title of "An Investigation in the Field of 16 mm. Film Production." Part I will examine and criticise present-day practice and Part II will contain details of recommended practices for obtaining the most satisfactory film presentation. It is hoped to complete the work by March, 1951.—*Report received and adopted.*

Newman Memorial Award.—The Secretary reported the recommendation that Dr. C. R. Burch, F.R.S., be awarded the Newman Memorial Plaque for his pioneer work in the design of optical instruments employing aspherical surfaces.—*Report received and adopted.*

1951 *Festival Committee.*—Your Committee holds the view that it would be desirable for a Kinematograph Industry Exhibition to be arranged during the period of the Festival of Britain. The equipment used in every branch of the industry would be exhibited. It was proposed that the first step should be an approach to the trade organisations to ascertain their views on the project.—*Received and adopted.*

Mr. P. H. Bastie.—Mr. P. H. Bastie's letter conveying his gratitude to the Council for the gift presented to him on the occasion of his retirement from the Office of Honorary Treasurer was read by the President.

The proceedings then terminated.

EXECUTIVE COMMITTEE

Summary of meeting held on Wednesday, June 7, 1950

Present :—Mr. A. W. Watkins (*President*), in the Chair, and Messrs. L. Knopp (*Vice-President*), H. S. Hind (*Hon. Treasurer*), Rex B. Hartley (*Hon. Secretary*) and I. D. Wratten.

In Attendance :—Miss J. Poynton (*Secretary*) and Miss S. M. Barlow (*Assistant Secretary*).

Election.—The following was elected :

Wilhemus G. Sips (Member) Filmstudio Profilti, Holland.

Resignation.—The following resignation was accepted with regret :—

Herbert E. Whitney (Member).

COMMITTEE MEETINGS

It has been decided by Council that reports of meetings of committees (other than the Executive) shall no longer be published. Instead, more complete reports of proceedings of Council (to which all committees report) will appear.

SIMON ROWSON, M.Sc., F.S.S., Hon. M.B.K.S.

Died 25th June, 1950

Members will have learned with regret of the death, after a long illness, of Simon Rowson. Obituary notices in other journals have described his accomplishments in various fields, and these will not be repeated. It is felt, however, that many members may not know of his distinguished place in the history of the Society.

When the British Kinematograph Society was formed in 1931, Mr. Rowson became its first President and his success can be indicated by recalling that he occupied that office, by unanimous vote, for the first seven years of the life of the Society. During those early years Mr. Rowson clearly established the principles on which the Society's activities

are based. He recognised at the outset the importance of complete emphasis on its technical purpose, and took great care to exclude either political or commercial bias from its deliberations. Under his guidance educational schemes were formulated and put into effect, the Journal was initiated, and a close association was formed with the British Standards Institution on matters of motion picture standardisation.

The annual dinners of the Society in the years before 1939 will long be remembered as extremely successful functions attended, each year, by distinguished guests. Simon Rowson, aided by a small but energetic sub-committee, planned those dinners in the greatest detail, and I have no doubt that the results obtained were largely due to the efforts of this small group.

Due to ill-health Mr. Rowson had not attended meetings of the Society for nearly ten years, but a short time ago he was made an Honorary Member as a tribute to the outstanding work he had done in leading the British Kinematograph Society during its important formative years.

I.D.W.

TOM HERBERT SCOTT

Died 18th June, 1950

T. H. Scott entered the kinematograph industry in 1920. He was a Past President of the Northern Branch of the C.E.A., and a delegate to the General Council. He was elected an Associate Member of the British Kinematograph Society in 1945.

PATRICK WILLIAM DAVIS

Died 19th June, 1950

P. W. ("Bill") Davis was chief projectionist at the Leicester Square Theatre from January, 1947, until his death. He had been on the projection staff at that theatre since 1934. He was a first-class projectionist, and his untimely death at the age of 40 is a great loss to the theatre side of the industry.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

D. F. Cantlay is representing England against Canada in a contest organised by the National Rifle Association.

David Hawkins, is engaged upon the production of "Quo Vadis" in Italy.

H. D. Waley has been appointed Technical Officer to the British Film Institute.

PERSONAL ANNOUNCEMENTS


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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SEVENTEEN, No. 2 — AUGUST, 1950

LECTURE PROGRAMME—AUTUMN 1950

Meetings (except that of November 24) to be held at Gaumont-British Theatre, Film House, Wardour Street, London, W.1, commencing at 7.15 p.m., Sunday 11 a.m. Meetings of the Sub-standard Film Division in the G.B. Small Theatre.

SOCIETY MEETINGS

Oct. 4 "**A 'Still' Man Looks at the Movies,**" by HOWARD COSTER, F.I.B.P., F.R.P.S. (Joint Meeting with the British Film Academy.)

Nov. 1 "**Motion Picture Presentation,**" by S. B. SWINGLER, A.I.E.E., M.B.K.S., and R. E. PULMAN, F.B.K.S.

Nov. 24 "**The Director's Problems** — illustrated from '**The Colonel's Lady**'," by K. ANNAKIN. (Joint Meeting with the Royal Photographic Society, to be held at 16 Prince's Gate, S.W.7, at 7 p.m.)

SUB-STANDARD FILM DIVISION

Oct. 11 "**Preferred Methods of Producing Films for 16 mm. Release.**" Discussion meeting opened by Members of the 16 mm. Investigation Committee.

Nov. 8 "**Precision Methods in Producing 16 mm. Colour Films,**" by DENIS WARD, Ph.D., M.B.K.S., F.R.P.S.

THEATRE DIVISION

Oct. 8 "**Planning the Festival of Britain Kinema,**" by WELLS COATES, O.B.E., Ph.D., F.R.I.B.A.

Dec. 12 "**Developments in the Theatre (Back Projection),**" by J. L. STABLEFORD, M.B.K.S.

FILM PRODUCTION DIVISION

Oct. 18 "**The Rational Application of Specialised Processes to Film Production.**" Special Effects—T. W. HOWARD, F.B.K.S., F.R.P.S. Art Direction—A. JUNGE, M.B.K.S.

Dec. 20 "**Economic Influences on Studio Lighting — New Methods and Techniques,**" by C. G. HEYS-HALLETT, M.A., A.I.P.E., M.B.K.S., and C. W. HILLYER, M.B.K.S.

JOINT MEETINGS WITH A.C.T.

Sept. 20 "**Practical Applications of Magnetic Recording — Tape and Film.**" A Symposium followed by a discussion.

Nov. 15 "**Technical Objects in Pre-planning Production,**" by K. E. HARRIS.

SCIENCE AND THE MOTION PICTURE INDUSTRY

Sir Robert Watson-Watt, C.B., D.Sc., F.R.S.*

Read to the British Kinematograph Society on April 29, 1950

YOU will be entitled to make two criticisms of what I have to say : first, that it should be addressed rather to the administrative, executive, and artistic sides of the industry than to the Society which contains primarily versatile members of the technical side ; second, that much of what I am to say applies, *mutatis mutandis*, to any industry.

Both criticisms have justification. First, however, I seek comfort and support from like-minded people in the B.K.S. before venturing to address myself, in appropriately modified terms, to other bodies where the climate of opinion may, I fear, be less far evolved from the just post-glacial age than in this genial temperate zone. As to the second, I have an uneasy feeling that this young industry, which is the offspring of the marriage of art and technology, with commerce and business administration as foster parents, has surprising strong vestiges of a resistance to the scientific method (as distinct from the technological product) which is rapidly disappearing from the older industries.

Science and the Film

I have recently been the recipient of some apparently free advice. Now a Scotsman who ekes out a precarious existence by selling advice is doubly cautious when he seems to be getting advice gratis. His first reaction is to consider whether the advice is worth just as much as he is paying for it. Then he goes on to consider whether in fact he is not paying ; and so I reflect that when I pay my half-crown for *Sight and Sound* a benevolent Lord President of the Council puts down two half-crowns—of your money and mine—to balance the account. Since the Lord President of the Council is, most fortunately, the nearest approximation we have to a Minister for Science, I am bound to wonder whether he thinks he is getting value for his (our) two half-crowns when he reads in the correspondence column:

> The film industry is both a business and an art, and is not a science . . . . . Science cannot determine the proper path to follow, for the industry is not like others. No film is the same as another . . . . . These factors are never constant, and consequently offer no fodder for the slide-rule.

And in the editorial columns, for which he must feel a more direct responsibility :—

> To claim that any general conclusions involving the artist can be drawn from " Operational Research " shows a complete lack of understanding of the artist's function . . . . . But at least let the two factors [Production Costs and Art ?] be kept apart . . . . . Is it even necessary to ask . . . . . ? It is vital to get the issues clear. . . . . .

Had these extracts and the accompanying text, which I have (a little unfairly) neglected to quote, been a little cleverer, a little more coherent, a little more considered, they might have " made me mad " ; as it is they merely make me sad. Of course it is vital to get the issues clear, but of course it is *always* necessary to ask. The editorial writer has done us one service by reminding us in a topsy-turvy way that the motto of science could well be: " It is *always* necessary to ask ".

Art and Technique

Much of the confusion of thought in our daily life is due to confusion of language. Especially in the moving picture industry are we cursed by confusion between at least two meanings of " art ", between two meanings of " technician " by confusion about whether indeed statistical research, production costs, and

*Scientific Adviser to the J. Arthur Rank Organisation.

the like (to quote again from the editorial pages) " can have no bearing on him " (the artist), and whether, at least, " . . . . . the two factors (can) be kept apart ". It is a singularly abstract view of the facts of life to suppose that the art of the artist, and the livelihood of the artist, can safely be kept apart. If they are, he is at least as likely to repine into premature mortality as into glorious immortality

I have said that there are at least two kinds of art in the film industry ; they are the two which are juxtaposed in the aphorism that " It is art to conceal art ". Like all good aphorisms this one is equally true in its reversed form (for which I claim the copyright) : " It takes art to reveal art ". I believe that the less " clever " but the clearer way to express these two equally true ideas is to say : " It is desirable that the artist be enabled to express his artistic mind without the technique used obtruding itself on the attention "; and : " It is the purpose of every artistic technique to enable the artist more fully and more economically to express his artistic mind ".

Need for Scientific Research

The particular confusion pervading the advice which *Sight and Sound* offers me is the assumption that analysis is unnecessary and undesirable because it is one step towards re-synthesis ; that it is not worth studying separately the mechanism of lung or heart or brain within the human body because the body is so much less useful if any one of these three organs be detached from it. Art, science, craft, finance, organisation, distribution, exhibition, sales, are all organs of that still living organism, the moving picture industry ; the industry may well die if we remove any one of them ; it may well die if we fail to study each of them severally on our way to the more difficult task of understanding them jointly.

The thesis which I hope to develop here is that we must have more scientific research in the moving picture industry. My hopes of sustaining my thesis depend, among many other things, on a paraphrase from one of our better publicised philosophers : " It depends on what you mean by ' the moving picture industry ' and by ' scientific research ' or, for that matter, by ' science ' ".

What is Science ?

Science has been defined by another of our philosophers as " The conscious unification of diverse elements ". Perhaps I may be allowed to dilute this extract of meat into a palatable beverage, by saying that the primary purpose of science is to attain the most compact and most comprehensive presentation of the common factors in apparently diverse things. But the everyday meaning of science in general goes as far beyond this partial definition as the definition goes beyond the bald dictionary description of science as "ordered knowledge". Science comprises amongst much else, a habit of mind and of method, as well as a continually growing stock of ordered knowledge.

If that be " science ", then good technology applies the same habit of mind and method to the utilisation of the stockpile of ordered knowledge. The ordered knowledge is at once the (temporarily) end product of a cultural process and the raw material of a technological process, the control of the resources of nature for the use and benefit of mankind. Without good science we can have no good technology ; without good technology we could have had no motion picture industry ; without more science we may well find that we have no British motion picture industry.

The motion picture industry is a complex of arts, sciences, technologies and administrative and organisational techniques. It is not, like all Gaul, divided into three parts, production, distribution and exhibition, for these three parts are served by a great network of ancillary industries : equipment manufacturing and like organisations providing appropriately designed and formed material, and personnel training organisations attempting—not yet adequately or wholly successfully—to provide appropriately selected and formed personnel. Each such unit is in itself no more than one of the interdependent organs in the single organism called the moving picture industry.

Science and Technology

Executives and artists have got as far as a comparatively cheerful acceptance of the need for technical development, for the engineering of improved or new devices. Not all of them have been sufficiently encouraged or alarmed into acceptance of the prospect that independent thought, the operation of head without hands, may change a whole process or method of approach in film making without necessarily changing one single item of equipment. In general the best results attainable at any given time will involve a change of method and a change of equipment, but we must maintain a wise balance between intensity of need and relative promise, between what we would like and what we can afford.

In such recent projects as Process Projection, Travelling Matte and Television-type aids in moving picture production it is fairly easy to trace the individual threads running through from the start in scientific research to the technological product. This I may be allowed to describe as the scientific plumbing of the industry. But how are we to decide, in advance, the relative place of these processes and equipments in any contemplated production ? Surely by an objective study of the cost—in the widest sense—of achieving an æsthetically satisfactory result, and of striking a balance between the emotional, educational and æsthetic value of the picture and the cost of the technological skills and ingenuities which we lavish on it.

Operational Research and the Film

The striking of this balance for the picture can be achieved only by standing back a little from the present, by a close study of the immediate and remoter past, if only to learn what to avoid. Operational research, like history, can be justified by its power to teach us how not to repeat our errors. The objective study of the " cost " of fidelity, or of deliberate symbolism which can be attained through technical equipment and the skill of the technician, to be balanced, as best may be, against the subjective estimate of the æsthetic and emotional effect achieved, lies within the sphere of Operational Research. But at least do not let the factors be kept apart—after we have studied them apart.

Operational Research, which took its shape and its name from a war-time recognition of something that had been done somewhat sporadically and sparsely before the war, has been too briefly defined as a scientific method for providing managements with information which is required for executive decisions. It is often assumed to be merely statistical research—slide-rules, correlation coefficients, and all that.

Because of that kind of misunderstanding, I should like to give another less compact outline of what it sets out to do. It sets out to study scientifically—that is, by methods depending essentially on measurement, however rough—what the " consumer " wants to achieve, the performance of the existing equipment in the hands of the available personnel. It tries out the effect of varying the main conditions of use one by one, to avoid ascribing a particular improvement to the wrong cause, and thence to discovering the relative importance and promise of several possible changes, whether in equipment, in the way it is used, or in the kind of people who use it. It goes on to suggest the kind of result which may reasonably be aimed at, to sketch the kind of equipment which might best conduce to these results, and the most promising ways of using it.

Scientific Management

All this, you may reasonably say, is a little of the job of business management, although it goes beyond what is sometimes, and sometimes a little optimistically, called scientific management. This is true, and I look forward with hope and confidence to the day when business management is done by people who have absorbed the scientific method and outlook in the course of their normal education, so that they separate their variables and measure their individual effects in a better than instinctive way. Then operational research will cease to be a thing requiring a separate name—but that day has not yet arrived.

Meanwhile it is is worth remembering that, just as no film is like another, no battle and no war is like another, that strategy and tactics, like films, are "made" by individuals, and so operational research in war was soon up against such elements as taste, style and talent. The commander on the other side was at least as unpredictable as the director or the star. Yet in war, operational research made great contributions to the full expression of the professional skill of the artist-in-warfare, at the same time achieving great economies in lives, effort and money. The factors were never constant, but the slide-rule controlled by the indefinable but readily recognisable quality called scientific common-sense sorted them out by such criteria as those illustrated in the night-fighter problems of the equipment and mode of use which might give either the shortest chases or the most kills—and the one does not necessarily lead to the other.

The Scientific Onlooker

There are, of course, important factors which are common to all battles, however different, and there are important factors which are common to all films, however different. There are, indeed, factors which are common to all battlefields and to all studios. Nor are there lacking common factors between military commanders who saw the value of operational research only after it had done good work for them in spite of their lack of enthusiasm for it, and some captains of our great, if temperamental, art-within-industry. The high command had to "try anything once" in the process of saving their country; some film makers have not yet recognised that it is worth trying any goodish-looking thing in the interests of saving their incomes.

The man-on-the-job must learn to believe that good can come out of the apparently detached observations of someone who has been trained to stand outside the daily run of the job; to watch critically, but understandingly, to ask questions (the true answers of many of which are obvious to the experienced worker, but of which perhaps 10 per cent will reveal examples of the differences among knowledge, beliefs, prejudices, hopes and vague impressions), and above all to reduce everything that can possibly be so treated to figures, however rough.

Cost of Research

The J. Arthur Rank Organisation, using advice which was based on experience in the apparently quite different field of the "Wizard War", as Mr. Churchill has called it, set up a scientific and technical structure to achieve these ends in film production. The department of the Technical Director in the studios, the Technical Requirements Advisory Committee, with its specialised sub-committees of user and provider, cost less in one year than one-tenth of one per cent of the annual Entertainment Tax collected by the industry. This seems a very modest figure indeed when it is compared, for example, with the $2\frac{1}{2}$ per cent of the gross value of its output, which is spent on scientific research by the average small business in the United States. Yet before it went into partial hibernation in this winter of our discontent, the structure had forwarded wise enterprises, and discouraged unpromising, unsound, foolish or extravagant undertakings, on a scale which saved the Organisation sums amounting to many times the expenditure.

It would be unprofitable to offer a movie parade of trailers on the achievements, positive and negative, of this research and development structure. A few of them have been discussed in full before this Society ; others might very profitably—and I hope will—be dealt with in separate papers of the same general type.

The J. Arthur Rank Organisation deserves well of the industry at large for the foresight, wisdom and courage which it demonstrated in founding this research and development structure, and for the freedom with which it has made available to the industry at large the first products of this scientific work.

Research in the Studio

But it is not enough that we should record appreciation of a promising start and grief at a temporary *rallentando*. The principal purpose of this perhaps platitudinous propaganda talk is to show that the British Motion Picture Industry, whose commercial success depends on the united " arts " of " artists " and " technicians ", cannot afford to be without at least one large, vigorous research and development unit, living in daily and hourly contact with the studio and the theatre, as well as with the academy and the workshop. In my view the offices and laboratories of the unit must be inside a large group of studios, for only thus can the researcher be kept in continuous touch with the hard realities of production ; only thus can the artist and the technician have adequate opportunity to see the researcher as one of their own intimate friends, sharing their aims and their ideals, their troubles and their triumphs.

There is no other major industry which is without some such unit, and if some have been worse served than others, the main cause has, I believe, been a too loose contact between the industrial units and the research units, a tendency to mutual aloofness due to the lack of the true familiarity which breeds better things than contempt. " Co-operative research " has sometimes been disappointing in its results, because the co-operation was not an all-level co-operation—and the blame lay with both sides and with most levels.

This is not an appeal for a " Kinema Research Association ", nor is it a suggestion that a research unit in every major studio group would solve the problems of the artist in " carrying his vision of life and truth safely through this dogfight of technicians ". It is an assertion that we can no longer base the advance of our industry on sporadic " invention ", insufficiently informed of the balance of needs and possibilities, on individually treasured " trade secrets " (which war-time co-operation in other industries showed to have been the treasured secrets of an astonishingly large number of holders, each guarding the same " secret " from others), on ingenious but individual craftsmanship.

We can afford to tell " the other fellow " all we know, confident that the strength of all we all know is much greater than that of its separate parts. Even if, as must happen, " the other fellow " is in Paris, Rome or Hollywood, the advance of the world motion picture industry is more important to the British part of the industry than is an advance in the British part alone—provided always that the British contribution is the best it can make.

Research in the Kinema

I have said little about science and the exhibiting side of the industry, not because there is not comparable scope for science there, but merely because it is more difficult ! So I take the easier things first, believing that a well balanced programme of research will involve much work in the theatres, but that the most important harvest from that work will be relatively slow in its gathering, merely because people are more complicated than things, and large groups of people more complicated than small. The work has begun, and will make its interim contribution to the consideration of what is most needed in production, but if I have to offer quick returns as an inducement to research I would look first at the studios, second at the technical equipment in the theatre, and, regretfully, only third at the audience as a unit.

THE EVOLUTION OF THE NEWS-REEL

Read to the British Kinematograph Society on April 5, 1950

I.—INTRODUCTION

Howard Thomas, M.B.K.S.*

THIS is a significant year in which to review the past, the present and the future of the news-reel.

A cycle has been completed. Fifty years ago a cameraman would film a national event, hurry to a West End theatre, develop the film, and then project the film himself to an audience that same evening. There are, in fact, in the audience tonight some of the " fathers " of the film business who did just that half a century ago.

Then, last Saturday, a film was made of the Boat Race and that film was shown on the same evening—by television. Television has caught up with what pioneers accomplished fifty years ago.

In the early days there was one negative, one cameraman, one print. Last Saturday, there were dozens of cameramen filming the Boat Race, along the tow paths, from the bridges and the tops of the riverside buildings, from the launches, from the air. There were thousands of feet of film to be developed and screened. Editors had to cut and shape the film ; commentaries had to be written and recorded ; music and sound effects had to be added ; duplicates had to be flown off to New York, Australia, Cape Town ; and the hundreds of prints had to be despatched to every corner of this island.

And now science has produced a new and simple way of accomplishing all this—a method whereby a single print (or it need be only a negative) can reach a million people within a few hours of an event taking place.

Television News

What must the kinema news-reels do to survive this young but immensely powerful competitor ? Where will the kinema news-reel stand in five years time?

These are questions vital not only to news-reel staffs, but to every member of this industry. But before we unveil the crystal ball and try to peer into the future I think it would be heartening to look back into the past—back to the early days of the news-reel.

It is difficult to trace the very first news-reel of all. In our own library at Pathé we have an event filmed in 1897—the Jubilee of Queen Victoria. We also have some Boer War pictures

It was not until 1909 or 1910 that a regular news-reel service came into being and Pathé Gazette was established. Charles Pathé and his brother started a reel in Paris, and a year later came to London and started the Gazette here.

I have no first-hand knowledge of those early days, but I have invited here tonight someone who knows a good deal about them and can speak from personal experience.

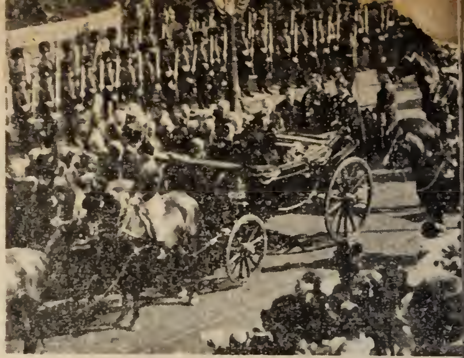
II.—THE EARLY DAYS OF NEWS-REELS

Kenneth Gordon†

(Copyright reserved by the author)

THE filming by Robert W. Paul of the Derby in 1896 may be described as the first news-reel ; this was followed the next year by the record of Queen Victoria's Diamond Jubilee. The story of the late René Bull, the great war artist, building a rostrum of bamboo poles in order to film the charge of

*Associated British-Pathé Ltd.
†Associated British-Pathé, Ltd. Newsreel Vice-President, Association of Cinematograph & Allied Technicians.

Courtesy of National Film Library

Four shots from early News-reels: the Derby of 1896; Queen Victoria in Dublin (1898); London Tra is from R. W. Paul's film, the

the Dervishes at the battle of Omdurman, and the London *Times* report o filming the action in Crete in 1897 by the war-correspondent F. Villiar constitute the first coverage of war news.

The First News Reel

The first regular news coverage was by the Biograph Company, an America firm which established laboratories in Great Windmill Street. Such news a the Boat Race and the Derby was covered at that time. Each subject was onl 160 feet in length, and a single frame measured 2¾ ins. by 2 ins.; this will giv some idea how short the subjects were.

In 1898, A. J. West inaugurated his combination of news and interest film of the Royal Navy, which for so many years ran in the West End of Londo under the title of " Our Navy ". Shortly after came the era of Charles Urban Will Barker and W. Jeapes. Their firms, the Warwick Trading Company an later the Charles Urban Trading Company, dealt mainly in one-reel new events, such as the Grand National, the Derby and the Boat Race. They wer shown the same night at London music-halls

A number of new firms were started to cover the great news events. Ceci Hepworth, whose pioneering work did so much for the British film production came into the picture. W. S. Barker founded the Autoscope Company, an W. C. McDowell and A. Bloomfield, two members of the Biograph Company started British & Colonial Films, Ltd. Each of these firms covered news a well as story pictures.

The Biograph cameramen covered the Boer War and the Russo-Japanes War ; W. K. L. Dickson and J. Rosenthal took both these events. During the Boer War the two photographers carried their very heavy camera, which perforated the stock at the same time as the film was exposed, in a bullock cart.

News-Reel Equipment

Later came the newsreels as we know them today. Pathé Gazette was at first filmed here and processed in Paris. It has been stated that the Gaumont Graphic followed only a few days later. Shortly after came the Warwick Chronicle (founded in 1903 by Charles Urban), Topical Budget (founded by Jeapes and W. Wrench, the projector engineer), the Williamson News, and the Eclair Journal. All produced two issues weekly—at 2½d. a foot.[1]

The cameras used were hand cranked—Pathé used their French model with outside boxes, Gaumont used the Prestwich, an English model, also with outside boxes. Moys, Williamsons and Eclairs were also used ; later Topical Budget used Debries, and Warwick started using the first automatic, the Proszinski Aeroscope. This was run by compressed air and the first models were fitted with a gyroscope to keep it steady when hand held.[2]

The Provincial Cinematograph Theatres, whose kinemas were among the first to be built as such in England, had dark-rooms in their chief theatres. Local films were taken, processed in the kinema, and shown the same night.

Speed of Production

About this time Charles Urban introduced Kinemacolor, and William


); and the Investiture of the Prince of Wales (now Duke of Windsor) at Caernarvon in 1911. (The first files of the Pathé Gazette).

Friese-Greene was experimenting with a process known as Biocolor. King Edward's funeral and the Coronation of King George V gave a great incentive to the news-reel producers, and many production records were broken, the laboratories working night and day. One of these speed records was made by Gaumont Graphic. They filmed the investiture of the Prince of Wales at Caernarvon. On the pilot engine of the Royal Train were coupled a pair of large milk vans ; these were turned into travelling dark rooms. The negative was developed, dried and rough cut, and a print was made on the way to London. As we sped along, every time we crossed any points, the developer, hypo and washing water would splash over and cover us. The developer was so low when we developed the print that it did not cover the frame, but the movement of the train saved the day, and the resulting film, nearly 1,000 feet in length, was shown the same night at the Electric Theatre, Marble Arch. The negative was re-washed before further prints were made.

The next year brought the Delhi Durbar, and mobile laboratories were sent to India. A special kit was made in Paris, designed by M. Santau, chief of the Gaumont Laboratories. The developing frame was cut like a gramophone record in brass ; the film stood up in the cuts, and a comb of brass was inserted in the top. Each frame took 200 feet of film, and fitted into a plated metal container which held the developer. The washing and fixing took place in bags of rubber waterproof cloth. The printing was by acetylene light which was more dependable than the local electric supply. About 200 prints were made before the negative was sent to London.

News in Colour

It was the colour version of this film, made by Charles Urban, that put news-reels in the big money class. Kinemacolor was made on a black-and-white print, using rotating filters both in the camera and in the projector, therefore it was able to be processed in the same manner as black-and-white. The colour film ran for a long while at the Scala Theatre, and many other key theatres throughout the world.

Charles Urban and Biocolor had some difficulties with patents ; the costs of the resulting law suits rendered them both bankrupt. Gaumont brought out Chronochrome, which stopped during the first world war.

About this time I had my first assignment in Turkey. This was during the Balkan war. My apparatus was an inside-box Prestwich camera, fitted with 3 in. and 6 in. lenses.

The First World War

During the first world war the newsreel firms banded together and formed the War Office Films Committee, under the Chairmanship of the late Sir William Jury. This enabled cameramen to work to a common purpose. One of them, J. B. McDowell, won the M.C. and the O.B.E. for his work on the battlefield.

The Government bought up the Topical Budget, and ran it as an Official War News. I joined them after the war and went to Russia as a war cameraman. Jeapes re-purchased this reel from the Government, and attracted the attention of many newspaper owners.

After this I went to Ireland to get some shots of the internal strife prevailing. The resulting films attracted bottles of ink when shown in the kinemas. Some people even used my films of the Black and Tans for target practice with revolvers.

News-Reel War

In England about this time a newsreel war was developing. The main cause of trouble was the granting of exclusive rights of the various sporting events. The Grand National was an example. This was the end of the " close season " for unemployed cameramen ; all who could stand were certain of work, either as a " pirate," with all expenses paid, or in the official party. One stranger, a " pirate," was looking around for a position ; I carried his gear, installed him, and left him quite contented, but ignorant of the fact that I had placed a " minder " with him to see that no film was taken.

At the last cup-final at Stamford Bridge, the flats at one end of the pitch was the position of one Pathé camera. This had been spotted by Topical Budget, the company who had the exclusive rights of this match, as was intended. Topical planned to fly a balloon in front of the camera, with a banner hanging from it, in an attempt to stop us " pirates '. They did as they had planned. We had another camera ready which was put into use, much to the consternation of Topical.

This was the time the Debrie " Sept " automatic camera was introduced ; it would run only 15 feet of film. I managed to get shots of the King inspecting the teams, a fair coverage of the game, and by good fortune the only goal, which was a penalty. Every roll was taken back to the office by messenger as soon as it was ready.

Exclusive Rights

Then Gaumont entered the war, buying up all the rights they could, some of which they shared with Movietone. Pathé lost the rights of the Grand National by being outbid, and we had to become a " pirate " at this fixture. Pathé used scaffold towers ; fights took place around these, although they were outside the course. The towers were built at the last minute ; on our stand were Jock Gemmell, with his range of long focus lenses, and myself with the slow motion camera. Then the fight was on. Our opponents got hold of the rope which we used to lift our gear, and started to pull the tower over. Just as this 60 ft. tower was about to topple over, someone cut the rope and we just managed to get our cameras lined up. The race had started. Then we were attacked for a second time. Fireworks were fired in front of the cameras, which frightened the horses, causing the favourite, Golden Miller, to fall in front of our slow-motion camera. That season's test matches brought out balloons, heavy net, and many other tricks to stop filming. The balloons were punctured by air-gun fire, and the pictures stolen.

Later the Newsreel Association was formed, and agreement reached on the conditions of exclusive rights. By competitive bidding the price demanded for the exclusive film rights had risen out of all proportion to the earning capacity of newsreels.

III.—THE DEVELOPMENT OF THE SOUND NEWS-REEL

W. S. Bland, M.B.K.S.*

ALTHOUGH I have been engaged in sound recording since 1929, I am a comparative newcomer to the news-reel field, and for information on the inception of news-reel sound, I am deeply indebted to George Newberry,

*Associated British-Pathé Ltd.

who has been recording for Pathé since the earliest days and has an unexcelled experience of those hectic times.

The Coming of Sound

The transition from silent to sound reels was a revolution which came virtually overnight, at a time when the fierce competition between companies gave no breathing space in which to assimilate the technical niceties of the new art or the temperamental nature of the equipment before the battle was joined on this new and noisy front. The new film speed of 24 frames per second, demanded to extend the range of recorded frequencies, meant a slowing up of processing and added fifty per cent to the amount of material to be handled. The call for controlled development to cope with the sound track on the picture negative reduced the individual treatment of negative to counter unfavourable exposure conditions.

At the outset re-recording was not considered. Silent sub-titles told the essence of a story shot with synchronised sound, so that sound coverage in the early thirties was very extensive and vast mileages were covered by sound crews as they chased from one end of the country to the other in an endeavour to record each major news story. The pace was such that requests for time off the road for maintenance went unheeded until the equipment refused to function.

It was some time before the art of narration was developed and the commentary was on occasions recorded live on location. There were even instances of the mixer delivering the commentary as he operated the equipment. The introduction of the commentator reduced the number of stories covered in sound and confined the coverage to bare essentials. Sound men once more had time to breathe.

Sound Technique

With the development of dubbing equipment and the amassing of a library of effects and music, the early preoccupation with natural sound waned, and the pendulum swung over to the use of music as a device to aid continuity and raise the dramatic value of the picture.

Perhaps this would be a good point at which to analyse the functions of the various ingredients of a newsreel sound track :—

1. Commentary serves to amplify the information presented visually or not obviously, and to link scenes.
2. Sync. sound serves to enhance authenticity, restoring the camera's reputation for truth, and to enhance the dramatic value of the action, aided where necessary by—
3. Library sound effects.
4. Music also raises the dramatic value and links disconnected visuals.

Some say, and I rather agree, that we have gone rather too far in the cult of noise to stun the audience into attention to our stories. Indeed, a return to sane use of natural sound without music could often be made with advantage to both the authenticity and dramatic content—and there are no royalties !

Early Equipment

The development of technique has always gone hand in hand with that of equipment.

The earliest combined cameras were made by the fitting of an attachment to a silent motor-driven camera. This comprised a box providing the extra film drive with some form of filter, together with a sprocket or gate where the exposure of the track was effected. The first equipment used by Pathé was the British Talking Picture gear, using a Photeon glow tube for modulation. All power was obtained from batteries, 1000 volts of which were provided for polarization of the tube. Albeit, the gear was sufficiently compact to be carried in a private car, with a telescopic camera mounting arranged to project through the roof. Carbon microphones were used and controlled processing was unheard of, consequently the results were at times surprising. This gear, used for the Boy Scout Jamboree at Birkenhead in 1929, was provided with four-way mixing facilities.

Exposure was a problem on the orthochromatic stock, but, judging from some of the sound produced on it, one would believe that it gave less image spread and fog than the panchromatic emulsions which came later.

The next move was towards condenser microphones and galvanometer modulators. While the condenser microphone was undoubtedly capable of much higher quality than its carbon counterpart, it was heavy and called for thick five-core cables to feed its amplifier. Humid conditions, too, brought noise troubles in their train. The early galvanometers were oil damped, sensitive to temperature, and liable to need re-stringing or a new mirror after heavy overwork. The first RCA channels were double film channels, bigger and heavier, calling for a truck and three-phase drive for synchronising purposes.[3] While this system undoubtedly gave improved quality, mobility was lost, and in due course a single film outfit was provided, coupled to a Mitchell camera with sound attachment added. That camera, minus the sound attachment, is still doing yeoman service.

The Fox system appeared with a glow-tube modulator, giving a variable density track.

Meanwhile, back at headquarters, changes were also taking place. New continuous processing equipment was designed and the quest for a uniform development demanded by the sound track started. Dubbing equipment was installed in viewing theatres, but in those days two soundheads seemed ample. Gradually the technique was taking shape.

Advances in Technique

Probably the greatest advances from the point of view of the news-reel recordist were the introduction of robust modulators, galvanometers or light valves, followed by moving-coil microphones. Away went the heavy cables, and the microphone became small enough not to obscure the face of a speaker. It became handy enough to permit a new technique in screen reporting, where the interviewer can become mobile and pick his victim out of a crowd. Moving-coil headphones at last gave the recordist a reasonable idea of what he was recording.

Always present was the trouble of ground noise from the negative stock, with its characteristics unsuited to sound. The need for stabilized power supplies for noise reduction units made their provision difficult in portable equipment. In England, Gaumont-British got round the problem by mounting the amplifiers in a truck and feeding the output to the single-film camera.

RCA produced a variable-area modulator, giving a Class B push-pull track which, of course, has inherent noise reduction. That is the basis of the channel used on our present day cameras. Unfortunately the news-reel rota system which operates on certain events and calls on us to supply material to other reels from time to time, prevents our using the Class B aperture, as not all other reels can screen the push-pull track.

The Present-Day

Gone is the erratic performance which was the main characteristic of the early equipment. The galvanometer is now extremely robust and stable and will withstand any amount of overload without derangement. Miniature valves and components, the perfection of small rotary transformers and vibrators for power supply, all play a part in providing gear of great reliability and portability.

The camera shows great improvement over the early models. It is particularly silent, and the provision of a flywheel-smoothed recording drum reduces flutter to a degree where people, perhaps less squeamish than myself, record music without a second thought.

Mention should be made of developments at the dubbing end, where all the flexibility of a first-class feature installation is provided, and used. Compression on commentary helps to get it over loud background sound and overall limiting helps the mixer who is still haunted by the speed bogey that he first met on the road twenty years ago.

Future Developments

Have we reached the limit of our technical progress ? By no means. Some day I feel that negative stock coated with a magnetic track area will overcome the bugbear of unsuitable emulsion characteristics. I foresee the use of a radio microphone to cross barriers unpassable by microphone cables.

Further ahead I can see the sensitivity of the television camera being harnessed for exposure under difficult lighting conditions, the output being recorded on film and used in the normal way.

IV.—THE FUTURE OF THE NEWS-REEL

Howard Thomas, M.B.K.S.

THERE are today five British news-reels; although two of them, Gaumont-British and Universal, are almost identical in content. These two reels belong to the Rank Organisation. Then there is Paramount News, allied to the international Paramount reel, and British Movietone, owned partly by Fox and partly by the Daily Mail group. And of course, Pathé News, which is linked with Associated British.

Of these Pathé and Gaumont have the largest distribution, reaching more than a thousand kinemas each. All the reels appear twice a week, and they are limited in length to a maximum of 700 feet. It is worth remembering that news-reels are the only films in Britain subject to stock rationing.* The reason, of course, is the tremendous quantity used, for something like one and a half million feet of film is used by the news-reels every week.

News-Reel Restrictions

Not only are news-reels restricted in size, but, because of the supplemental contract, they are tied to the kinemas which booked them during the early part of the war. Prices charged to kinemas are still at pre-war level. Production costs are much higher than before the war, and today something like £400,000 a year is spent on the production of news-reels, plus the cost of printing 80 million feet of film.

The news-reels are also limited to fixed release times, on Mondays and Thursdays, falling in with the film industry's general transport service, although for special occasions the reels do use aeroplanes and special transport. In this respect the greatest difficulty is Saturday sporting events, because this means making special arrangements with the laboratories. The competition of television may result in greater efforts for topicality in the kinema news-reels, and the future may bring week-end work as a regular practice.

Television and the News-Reel

This is perhaps the moment to survey the impact of television on the kinema news-reels.

My personal opinion is that television in general will not harm the kinema. I believe, for instance, that excerpts from good films, well presented on television, will induce many viewers to look for those films in the kinemas. I think, too that television will help the documentary film, and accustom audiences to

*Recently relaxed, but not rescinded.

documentary technique, making such films more acceptable in the kinema than they have been.

But the effect of television on news-reels is rather different. News-reels are the first branch of the industry to be directly affected by television. It is almost inevitable that they will lose their former advantage of urgency and topicality. Television has the benefits we have already described. Either the B.B.C. can film an event straight off the tube as it is being televised, or they can send out cameramen to a morning event, process and edit the film during the day, and include it in the same evening's newsreel.[4]

There are already daily news-reels in New York. Every morning they start with a blank screen and come out with a 10-minute news-reel at seven o'clock.

In a year or two, there will be a television set in the homes of most kinemagoers. Audiences will become impatient when they see on the kinema screen an event which had been on the home receiver a few days or even a week or two before.

There are some events which will survive this delayed screening. The big spectacular shows will always stand repetition. In any event the small home screen does little justice to spectacle and there is a loss of the detail that most kinemagoers enjoy. Royal weddings, Grand Nationals, Derbys, Cup Finals, will always be worth seeing a second time on the big kinema screen, but unfortunately there are all too few events on that scale. The kinema news-reels will lose out on stories with fleeting topicality.

News-Reels will use Television

So there will be two courses open to the newsreels. One will be to alter their shape and presentation so that there is compensation for the loss of topicality. The other (and this is outside our control just at the moment) will be for news-reels to get into television themselves.

The first stage will be when news-reels have television cameras at news events, transmit the resulting pictures to their laboratories, and film the result on the television tube. That step is within reasonable possibility, because news-reels would have a good case for a waveband for such private purposes.

Television in the Kinema

But the biggest development of all will be when news-reel crews can handle their own television cameras and transmit direct to kinemas, with live news as it happens. This whole question is now being considered by the Beveridge Committee, and the film industry has applied for the right to televise.

There is no doubt that if the kinemas could have live television (with their own programmes, not B.B.C. programmes) it would be a tremendous stimulus and a new attraction for audiences. My vision of the kinema programme of the future is a feature film, a documentary or reporting film, a cartoon, and half an hour of television. That half-hour would include a news-reel, partly live news happening at that moment and partly some events which had taken place in the afternoon and being repeated on film. The rest of the programme would consist of, say, a television tour of the town.

I would like to see three or four kinema television networks, competing for events—and for audiences. Then there would be no occasion to worry about B.B.C. Television competition.

Above all, I see that sort of television service operated by the news-reel companies. Their technicians have the flexibility, the " know-how ", the flair for composing pictures and making fast decisions.

Interpretative News-Reels

But before then, the other course open to news-reels is a re-styling of their product.


The Atom Bomb Explosion at Bikini Atoll; and the first Photograph taken of the edge of the World, by a Camera carried in a V.2 Rocket at a height of 60 miles in New Mexico.
(Both photos by Pathé News.)

With topicality at a discount, news-reels will have to become more interpretative. News-reels will have to become film digests, *explaining* to the public, in an entertaining way, the background to the news and its significance. Instead of emulating the daily newspapers, the news-reels will have to take their cue from *Newsweek*, *Time* and *News Review;* to place news events into proper juxtaposition and to point out their implications. It is no secret than my company has already started to make plans for re-styling its newsreel in this way. In fact it is so public that the shape of our newsreel of tomorrow is already on the screen today. Every three months we produce a quarterly survey of the news, making it as calm and dispassionate as we can. This was first made for schools, then it spread to the Services (all three of them use the series in their Current Events courses) and finally " Summing Up " (as we call it) is being shown regularly in the kinemas. It is a blend of news material, of screen reporting, of documentary film making.

And so, we step forward into the second half-century of news-reels. Whatever comes, television, colour, stereoscopy, the news-reel technician will be there, extemporising, adapting himself to every emergency and to every new situation. There is still tremendous vigour and enthusiasm in the news-reel business; and wherever, however, the film industry develops, the news-reel men will be right out there in front. News-reels were there to see the twentieth century in and will still be in the picture when we see the century out.

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3. *Proc. B.K.S.*, No. 11 (1932).
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DISCUSSION

MR. MERCER: The introduction of colour would be a great asset.

MR. THOMAS: The answer is the time factor. Processing takes so long that a film cannot be topical.

We are experimenting all the time. We tried a new process recently—it was many weeks before we received the first print. News-reels need the material within hours.

MR. GORDON: Kinemacolor was taken with negative stocks no different from those we are using to-day and could be screened the same night. Picture fringing was present, due to taking one picture after another; but by using prisms this could be avoided.

MR. H. S. HIND: I query this question of the need for speed in news-reels. Will television, because it does things so quickly, keep people from seeing the news at their kinema?

A new technique of producing films in retrospect would prove extremely popular.

MR. THOMAS: The answer lies with the exhibitor. If he did not receive his pictures of news events within a few days he would be very unhappy. Exhibitors will not wait for news pictures to appear in colour.

MR. B. HONRI: I do not remember any fringing in Kinemacolor except when there was fast movement. If the film were shot to avoid fast movement, I think a great deal might be done with the system.

MR. A. SIMON: About 1925 we tried to revive the Kinemacolor process, taking advantage of the progress made in new lenses and panchromatic emulsions. But it was not good enough, as compared with Technicolor. Colour pulsation cannot be eliminated. The pictures must be taken through a prism at the same time, and projected at the same time.

Mr. R. H. Cricks : I endorse what Mr. Simon has said. Shortly after the date he mentions, I co-operated with the late Claude Friese-Greene with the object of devising a method of eliminating pulsation and fringing. But we found it impossible to eliminate these faults.

A Visitor : What sort of speed is possible with the new bi-pack processes ?

Mr. Thomas : We have made one or two experiments. For this evening's discussion we investigated the possibility of filming the Boat Race in colour, but we could find no process capable of filming the event on Saturday and enabling us to project tonight, four days later.

Mr. Moylan : I feel a little confused over a statement made by Mr. Bland on the subject of music for news-reels.

Mr. Bland : If you can have natural sound it does give a greater effect of authenticity than a silent picture or a commentary can.

Mr. Moylan : You mentioned that you had no facilities for editing or recording magnetically. It is a system I am using myself.

Mr. Bland : We are well aware of the virtues of magnetic recording. I should like to see the production in this country of the highly portable high quality synchronous magnetic recorders available in America.

THE INVENTION OF KINEMATOGRAPHY

In course of a review in the *Bulletin de l'Association Française des Ingénieurs et Techniciens du Cinéma* of Miss Ray Allister's book "Friese-Greene : Close-up of an Inventor," Monsieur Jean Vivié, secretary of the Association, refutes the claims made for Friese-Greene as the inventor of kinematography (see the May issue of this journal, p. 156). He makes the claim that in 1887, the French scientist Marey, who had previously produced motion pictures by the aid of a continuously moving glass plate, devised an electro-magnetic system which imparted an intermittent motion to the film, the movement of which was masked by a shutter. The following year he replaced this system by a purely mechanical device, The system was demonstrated to the Académie des Sciences on November 3, 1890.

M. Vivié refers to his work, "Historique et Developpement de la Technique Cinématographique." It appears from this that it was not until three years later that Marey, in conjunction with Demény, constructed a projector to run the films so produced.

Miss Allister's book forms the basis of the film to be produced for next year's Festival of Britain.

AMERICAN STANDARDS

Six American standards are published, five relating to 16 mm. films, and one to kinema screen frames. (See *J.Soc.Mot. Pic.Tel.Eng.*, April, 1950).

Z.22.7—1950 : *Location and size of Picture Aperture of* 16 *mm. Motion Picture Cameras.*

The camera aperture measures .402 in. × .292 in. The film is guided laterally from the edge nearer the sound-track.

Z.22.8—1950 : *Location and size of Picture Aperture of* 16 *mm. Motion Picture Projectors.*

The projector aperture measures .380 in. × .284 in ; it is recommended that the aperture should be between the film and the light source. The film is guided laterally from the edge nearer the sound-track.

Z.22.19—1950 : *Location and size of Picture Aperture of* 8 *mm. Motion Picture Cameras.*

The camera aperture measures .188 in. × .138 in. The film is guided laterally from the edge nearer the perforations.

Z.22.20—1950 : *Location and size of Picture Aperture of* 8 *mm. Motion Picture Cameras.*

The projector aperture measures .172 in. × .129 in. The film is guided laterally from the edge nearer the perforations.

Z.22.78—1950 : *Mounting Frames for Theater Projection Screens.*

A range of screen frames is specified for screen sizes Nos. 8 to 30. Sizes of wood structural members are suggested.

Z.22.79—1950 : 16 *mm. Sound Projector Test Film.*

A 200 ft. film is described, containing samples of tracks from feature productions.

Two newly published American standards relate to 16mm. films for testing uniformity of illumination along the scanning beam. Both films carry a 1000 c/s recording, .005 in. in width, moving across the width of the track. No. Z22.80—1950 describes a laboratory type film, 34 ft. in length, while Z22.81—1950 describes a service type film, 3½ ft. in length. The method of use is described.

A draft standard, No. Z22.82, relates to the sound transmission of projection screens, and requires that the attenuation at 6000 c/s with respect to 1000 c/s be not more than 2½ db., and at 10,000 c/s with respect to 1000 c/s not more than 4 db. Variation from a smooth curve between 300 and 10,000 c/s shall not exceed ± 2 db.

HISTORY AND DEVELOPMENT OF THE COLOUR FILM

R. Howard Cricks, F.B.K.S., F.R.P.S. and B. J. Davies, M.B.K.S.*

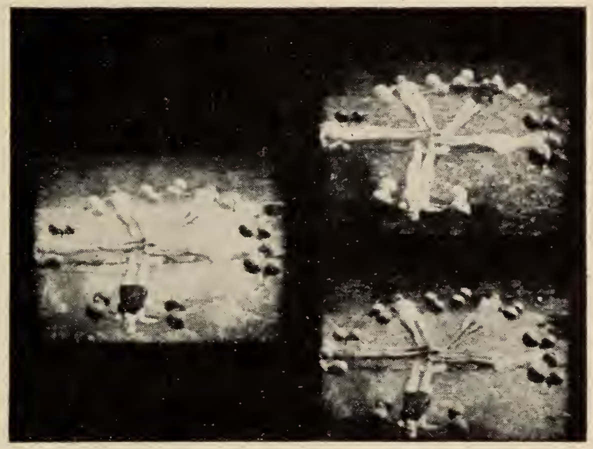
Summary of addresses to the B.K.S. Theatre Division on April 16, 1950.

THE April meeting of the Theatre Division was announced as a demonstration of colour processes ; unfortunately it proved impossible to secure examples of recently announced processes, and instead a brief review was given of the history and development of the colour film.

Additive Systems

Mr. Cricks commenced his survey with the work of William Friese-Greene in the 1890s, which led to the two-colour alternate-frame sytems.[1] Notable among these was Kinemacolor,[2] the world's first commercial colour process, developed by George A. Smith and handled by Charles Urban ; it was however proved in Court to have been anticipated by Friese-Greene's work.

After the first world war, we had seen a spate of additive systems, most of them employing two or three small images in the space of a normal frame ;



A Frame of Francita-Realita Film. Left Green Image, top Blue, bottom Red.

obvious objections to such systems were the loss of definition, and the difficulty of registration when the film shrank. An example of such processes was the Francita-Realita[3] system illustrated.

A more advanced principle was the colour-element system, which derived from the Finlay system, and was developed by a French worker, Dufay, becoming the well-known Dufaycolor system[4]

All additive systems, however, resulted in a loss of light in projection, theoretically two-thirds, but at least half. For this reason attention turned to the subtractive processes, notwithstanding the many advantages of the additive principle, notably ease of processing.

Bi-Pack System

Turning next to the subtractive processes, Mr. Cricks described the simplest of these : the bi-pack negative. This consisted of two films run together through the camera gate, the front one sensitive to blue and green, and the rear one to orange and red. After development, they were printed one on each side of the positive, which was toned blue-green and orange-red respectively, the usual method of processing being to float the film over the dye.

*Kodak Ltd,

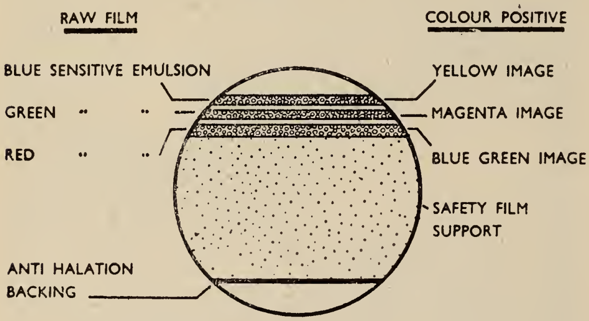
The earliest of such systems was produced by Agfa ; other systems embodying similar principles were two-colour Chromart, two-colour Cinecolor, Alfacolor, and Technichrome. Recent systems of the type endeavoured to introduce a third colour in the processing ; the overlap in the sensitivity of the two negative films might, for instance, serve to control the application of a yellow dye.

Three-colour Assembly Systems

The next stage was the development of the three-colour assembly process, exemplified by Technicolor [6,7] and Dufaychrome. The former was processed by the imbition method, a gelatine-coated matrix film being differentially hardened so that the amount of dye picked up by it, and transferred to the print, varied with the depth of colour. The latter system the speaker believed made use of a re-sensitising process for the successive application of the second and third colours.

Kodachrome Process

Mr. Davies then explained the principle of the monopack or integral tripack processes, earliest of which was Kodachrome.[5] [6] He illustrated the structure of the film with its three emulsion layers, and discussed the method of processing, which involved separate colour-development of each layer. The sound track was of silver sulphide, and was processed between the yellow and magenta developments. The use of direct positive recording avoided one copying



Section of Kodachrome Film, showing Colour Sensitivity and Dyes resulting from Processing.

operation ; signal-to-noise ratio and volume level were slightly lower than with black-and-white.

For commercial purposes 16 mm. Kodachrome had occasionally been " blown-up " to 35mm. Technicolor. Normally 16mm. copies were made on Duplicating Kodachrome emulsion, which was similar to the camera films.

Agfa type Systems

Mr. Cricks then summarised the work of Dr. Fischer, which resulted in the widely used system of integral tripack, such as the Agfacolor[8, 10] and Ansco-color [7, 10] processes, which however differed from the Kodachrome process in that coupling dyes were embodied in the three layers, producing the different colours in the single development operation. He discussed the problems of processing,[9] differentiating between negative-positive and reversal processing ; he expressed preference for the latter, because in his view it enabled the inevitable faults of any system to be cancelled out.

The camera film need not, even if it were processed by reversal, show a true range of colours, since it was needed only to expose the positive. Slides showed the marked difference between typical negatives and the positives made from them. The use of a viscous bleach to produce a sulphide opaque sound track was described.

The addresses were illustrated by the projection of sequences from the following films : " A Song is Born " (Technicolor, shown by courtesy of RKO Radio Pictures Ltd.) ; " Autumn Tints " (Kodachrome, shown by courtesy of Kodak Ltd.) ; and a Russian cartoon in Agfacolor (shown by courtesy of the Soviet Embassy).

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7. *Brit. Kine.*, 14, No. 2, Feb., 1949, p.43.
8. *J. Brit. Kine. Soc.*, 9, No. 3, July 1946, p.90.
9. *Brit. Kine.*, 13, No. 4, Oct., 1948, p.109.
10. *Brit. Kine.*, 11, No. 5, Nov., 1947, p.142

DISCUSSION

MR. A. E. ELLIS: Mr. Cricks appears to have omitted reference to the poor results that can be obtained if there is anything wrong in the processing.

MR. CRICKS : In processing Agfacolor and similar systems, it is necessary to keep the chemicals at a temperature constant to within $\pm\frac{1}{2}$°F. Correct colour balance in printing is most essential ; no fewer than 90 filters of different colours and densities are used to maintain balance.

MR. A. E. ELLIS: I handled a number of films made by the Friese-Greene process, notably " The Open Road ". The positive consisted of alternate red- and green-dyed frames, and if projected at the then normal speed of 16 frames per second, colour pulsation was very pronounced ; we found it necessary to adjust the projector to run at a speed of 24 frames per second. We had to use Crookes's glass to reduce the light intensity and prevent pulsation.

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library.

REPORT OF LENS-CALIBRATION SUB-COMMITTEE

J. Soc. Mot. Pic. Eng., October, 1949, p. 368.

This sub-committee was appointed primarily to establish a standard method of photometrically calibrating diaphragm openings for motion picture camera lenses on the *t* number basis as distinguished from the usual *f* system of markings. The report defines *f* and *t* numbers and accuracy of marking. Methods of photometric calibration are given. The use of *t* stops with existing exposure meters and guides is considered. The committee holds the opinion that either *f* or *t* stops may be used interchangeably for the computation of depth of field. A. H. A.

MEASUREMENT AND AUTOMATIC CONTROL OF LIGHT

A. Lennartz, *Foto-Kino-Technik*, Dec. 1949, p.305.

For the measurement of the colour of light, two photo-cells, sensitive respectively to red and blue, are connected in a bridge circuit. The output may be amplified and caused to control the burning rate of an arc lamp, so maintaining a constant colour temperature. R. H. C.

HIGH SPEED PHOTOGRAPHY

J. Soc. Mot. Pic. Eng., Nov. 1949.

A symposium on high-speed photography and kinematography includes descriptions of numerous types of cameras, capable of working at all speeds up to a million exposures per second. Applications of such apparatus include research in guided-missiles, Schlieren photography, cathode-ray oscillography, and shock measurement. Light sources, view-finders, and the use of colour film are discussed. R. H. C.

A NEW FORMULA FOR REVERBERATION PERIOD

Bull. de l'Assoc. Franç. des Ing. et Tech. du Cinéma, No. 6, 1949, p. 20.

The author examines the standard formulae of Sabine and Millington, the one linear the other exponential, and finding both unsatisfactory, proposes a new formula for the determination of reverberation time in an enclosed space. H.L.

LEAD-SULPHIDE PHOTOCONDUCTIVE CELLS IN SOUND REPRODUCERS

J. Soc. Mot. Pic. Eng., Dec. 1949, p. 691.

The theory of operation of the cell is reviewed, and data given concerning sensitivity, spectral response, frequency response and performance with commercial colour prints.

N. L.

DUPLICATION OF MAGNETIC TAPE RECORDINGS BY CONTACT PRINTING

R. Herr, *Tele-Tech.* Nov., 1949, p. 28.

A method of duplicating magnetic tracks is described in which the master track and virgin tape are held in close contact while passing through an alternating magnetic field. Measurements of printing loss are given and methods of equalising indicated. N. L.

DUO-CONE LOUD SPEAKER

H. F. Olson, J. Preston and D. H. Cunningham, *RCA Review*, Dec., 1949, p. 490.

This loud speaker unit has been developed from an earlier model previously described. Features include a high frequency cone mounted within the apex of the larger low frequency cone, the two being nearly congruent. A single magnet is used, having the two concentric gaps which form a series magnetic circuit. Performance curves and data indicate an effective frequency range from 40 to 12,000 c/s. N. L.

" KOLORIG " DEVICE FOR KINEMA SCREENS

Tech. Ciné., Nov., 1949, p. 244.

A projection screen is mounted a short distance from another larger screen, which is colour-flooded, giving the appearance of a coloured border to the picture. Its colour and intensity are manually controlled to suit the picture projected. R. H. C.

A SIX-MEGACYCLE COMPATIBLE HIGH-DEFINITION COLOR TELEVISION SYSTEM

RCA Report. (*Exhibit* 209 *submitted to the Federal Communications Commission.*)—*RCA Review*, Dec., 1949, p. 504.

A general description of the latest RCA colour television system now being demonstrated to the FCC, and developed out of their original " simultaneous " system (*RCA Review*, Dec., 1946, p. 459). The new feature is compression of the three colour channels into one by pulse sampling them at picture point frequency, giving " dot sequential " colour scanning. The sampling frequency is arranged to give dot interlacing, reducing colour picture frequency from 30/sec. to 15/sec., and saving 2/1 in bandwidth. The " mixed high " feature, for reproducing fine detail in monochrome, is retained. RCA claim no loss of definition in a colour picture compressed into the same channel width as a monochrome picture. The new system is " compatible ", *i.e.*, existing monochrome receivers would still receive the picture in monochrome. Various receivers and colour converters are described.

L. C. J.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library

OPEN-AIR KINEMA IN VIENNA

An open-air kinema seating over 26,000 has been opened in Vienna. The picture width is 45 ft. Ernemann VIIb projectors are fitted with Magnasol arcs running at 140 amps. *Foto-Kino-Technik*, August, 1950.

SYNCHRONISING FILM AND TAPE

In a method of synchronising a magnetic tape with a film, the tape carries at regular intervals some mark such as a cross. These marks are viewed after reflection from a rotating mirror driven from the projector, and when film and tape are correctly synchronised the marks will appear stationary. *Photo-Service Gevaert*, March-April, 1950.

THE LIBRARY

By the generosity of the General Electric Co., Ltd., fluorescent lighting has been installed in the Library. A table has been provided by the kindness of the J. Arthur Rank Organisation.

BULGARIAN TRAINING COURSES

Following the example of Yugo-Slavia the Bulgarian government has inaugurated a school of kinematography. The three sections, respectively for camera work direction, and organisation, will each provide courses lasting 2½ years.


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THE COUNCIL

Summary of meeting held on Wednesday, July 5, 1950

Present : Mr. L. Knopp (*Vice-President*), in the Chair, and Messrs. H. S. Hind (*Hon. Treasurer*), Rex. B. Hartley (*Hon. Secretary*), D. Cantlay, F. G. Gunn, B. Honri, S. A. Stevens and I. D. Wratten.

In attendance : Mr. R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. T. W. Howard, N. Leevers and R. E. Pulman.

Death of the First President.—The Vice-President paid tribute to the work of Mr. Simon Rowson, M.Sc., F.S.S., Hon. M.B.K.S., and the Council stood in silence as a token of respect.

Sub-Standard Film Division.—Mr. W. T. Rudd was co-opted to the Divisional Committee and Mr. J. Masterton was appointed Divisional Representative on the Membership Committee.

The following Sub-Committees, with power to co-opt, were appointed to carry out an Investigation in the Field of 16 mm. Film Production. Specialists had been asked if they would either serve on the Sub-Committees, or act in an advisory capacity.

Sound Recording

Messrs. N. Leevers (Chairman).
R. A. Ball.
C. C. Buckle.
P. Heath.
M. V. Hoare.
A. Tutchings.

Photographic.

Messrs. M. V. Hoare (Chairman).
D. Cantlay.
G. Craig.
G. S. Moore.
Representatives from Denham and Brent Laboratories.

Projection Equipment.

Messrs. W. Rudd (Chairman).
L. Baker.
D. S. Morfey.
N. W. Wooderson.

Presentation.

Messrs. H. S. Hind (Chairman).
L. Baker.
J. W. Hissey.
M. Raymond.

—*Report received and adopted.*

Theatre Division.—Matters relating to the membership of the Society were considered. A case was made for inclusion in the Journal of material of greater appeal to projectionists, and it was suggested that members would welcome exhibitions of new developments in equipment at meetings.

Certain regulations, governing the Society's membership, were reviewed and consideration was given to the difficulties and requirements of members in various sections of the industry. —*Report received and adopted.*

Film Production Division.—The studio representatives had been informed of the course in Studio Lighting and the programme of papers for the 1950/51 Session. The course in Studio Lighting would be of interest to lighting cameramen, members of camera departments and others. It would commence in mid-October and comprise eight lectures, taking place on Monday evenings.—*Report received and adopted.*

Journal and Papers Committee.—The necessity for the work of the Papers and Journal Committees to be more closely linked led to the amalgamation of the two Committees. Mr. I. D. Wratten relinquished the Office of Chairman of the Committee owing to other commitments and Mr. N. Leevers was appointed to take his place.

Two Sub-Committees had been appointed to meet regularly and be responsible for the work previously undertaken by two separate Committees. The amalgamated Committee would meet at intervals throughout the year to review the work of the two Sub-Committees and, if necessary, make recommendations.

Papers Sub-Committee.

Messrs. R. J. T. Brown (Chairman).
C. H. Bell.
B. Honri.
N. Leevers.
G. I. P. Levenson.

Journal Sub-Committee.

Messrs. H. S. Hind (Chairman).
G. Parr.
Hon. Secretary.
The Editor.
The Editorial Assistant.
The Secretary.
The Assistant Secretary.

Report received and adopted.

[*Continued on p.* 64

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1951 *Exhibition.*—An approach had been made to various trade organisations to ascertain their views concerning the proposed Kinematograph Industry Exhibition. Replies were not yet to hand.—*Received and adopted.*

SPECIAL NOTICE

The Council of the Society is arranging a Dinner-dance to be held at Grosvenor House, Park Lane, London, W.1, on Thursday, February 15, 1951. Details will be announced later.

BOOK REVIEW

THE DIARY OF A FILM. Jean Cocteau. Dennis Dobson, 10*s.* 6*d.*

After reading the "Diary of a Film", one can understand more easily the mind of the great French film director Jean Cocteau. His most recent presentation in this country, "Orphée," has created quite a stir in the industry. This book tells the day-to-day details of a slightly earlier film of his "La Belle et la Bête". The technical details of its production are neglected slightly to the inclusion of the many personal incidents of the director, artistes and technicians, which occurred during the ten months the film was being produced.

In a preface to his diary, Jean Cocteau states : "I do not aim at poetry. That must come of its own accord. The very word whispered will frighten it away. I will try to build a table. It will be up to you to eat at it, to criticize it, or to chop it up for firewood."

A.R.R.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

R. I. T. Falkner has joined Decca Cameras.

W. F. Garling is paying an extended visit to the United States.

Eric Williams has returned for a short visit from Australia.

I. D. Wratten is at present in the United States on business.

PERSONAL ANNOUNCEMENTS

16 mm. PROJECTOR. Bobby & Co. Ltd., Eastbourne, require a good second-hand projector for Staff Training purposes. Please send details to General Manager.

FOR SALE : Mobile Disc Recorder as supplied by Standard Telephones Ltd., in 1949. Excellent condition. Write for full particulars to Box No. 9604, British Kinematograph Society, 117 Piccadilly, W.1.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.


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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SEVENTEEN, No. 3 SEPTEMBER, 1950

PRINCIPLES OF COLOUR SENSITOMETRY

The report of the Colour Sensitometry Committee of the Society of Motion Picture and Television Engineers is printed in the June, 1950, issue of that Society's journal; by courtesy of the editor, it is here abstracted by

Jack H. Coote, M.B.K.S., F.R.P.S.

THIS most valuable report has been produced in a remarkably short time by a sub-committee which must have had great enthusiasm for its work. The sub-committee was formed in March, 1949, and now, in 1950, it has presented what its Chairman, in his foreword, rightly describes as "one of the most urgently needed contributions the Colour Committee could make to the membership of this Society and to the industry as a whole."

The report is presented in nine sections, having the following titles :

I. Introduction.
II. Sensitometric Exposures.
III. The Processing of Sensitometric Tests.
IV. Quantitative Evaluation of the Image.
V. Densitometer Design Principles.
VI. Transformation Between Integral and Analytical Densities.
VII. Interpretation of Sensitometric Results.
VIII. Statistical Aspects of Colour Sensitometry.
References.

—INTRODUCTION.

The introduction commences with the statement that "Colour photography is an exacting endeavour," and this premise is supported by similar statements : "Economical practice of colour photography affords little room for operation by guess or even by estimate. It demands operation by measurement."

For the most part, colour sensitometry has been built upon the basic principles established in the sensitometry of black-and-white materials. However, some principles are new, and it is the primary purpose of the Report to describe the new methods and instruments of colour sensitometry.

The report is primarily devoted to subtractive processes, and most of the methods dealt with have been developed for use with three-component multilayer subtractive films—those forming cyan, magenta and yellow dye images in three separate sensitised layers, all on the same support.

I—SENSITOMETRIC EXPOSURES.

The fact that colour materials now available are widely dissimilar in characteristics and application prevented the Committee from giving specific details of exposure technique. The one guiding principle which the Report stresses is that " The sensitometric exposures should duplicate as closely as possible the conditions of actual use."

The application of this principle determines that the sensitometric exposure device should vary the intensity and not the time of the exposure given to test strips. It is considered that a carefully selected step wedge provides a satisfactory device for varying light intensity without seriously changing the spectral quality of the radiation. In general, it is considered that photographic (silver) wedges are less selective in their transmission than those using colloidal graphite.

Wedges having density increments of 0.15 ($\sqrt{2}$ factor) are quite satisfactory for all-round use, and the density range should be from about zero to 3.0. When the width of each step of the wedge is 0.4 inches, the cost of test film is held at a minimum without there being undue risk of misleading results arising from " adjacency " effects. The other dimension of each step should be at least as great as 0.4 in., but will often extend across the entire width of the film.

To avoid the remaining risk of inaccuracies arising from reciprocity law failure, it is essential to use a sensitometric exposure time which is nearly the same as the film would receive in the camera or printer. In other words, camera stocks should be exposed for 1/50th second in the sensitometer, while printing stocks used in step printers will usually be given somewhat longer exposure—probably between 1/10th and 1/20th second.

Selective Exposures of Individual Layers.

The usual practice at present is either to expose the three emulsion layers of a colour film in combination to obtain a grey scale, or to expose the emulsion layer selectively to produce the individual subtractive colours separately ; while sometimes both types of exposure are given.

Each of these exposure methods yields some information which the other does not, and the report recommends that complete sensitometric testing of colour film should include non-selective grey scale exposures as well as selective exposures of individual layers.

If the film to be tested is balanced for daylight, the sensitometer should be equipped with a combination of light source and filters which will produce simulated daylight. Such conversion filters as the Davis-Gibson liquid type, or the Corning Series 5900, are recommended.

Exposures for Sound Track Control.

Sensitometric exposure for sound track control should conform to the conditions employed in practice. If special treatments are involved, for example, the conversion of the track image to one of silver sulphide, then the sensitometric exposures must be treated in the same way.

III—THE PROCESSING OF SENSITOMETRIC TESTS.

This section commences with the following important and clearly stated observations :—

> The image which results from the processing of a controlled sensitometric exposure is determined by two factors : (*a*) the characteristics of the particular piece of film on which the exposure was made, and (*b*) the characteristics of the process through which the film has passed. Normally both sets of characteristics change with time. If one of these factors can be held constant, sensitometric images can be used as controls for the other factors. This has been attempted in two ways :—
>
> (1) To study variations between different samples or different coatings of the same type of film, sensitometric exposures are handled on a " sensitometric process " that is considered constant and free of the day to day changes and gradual drifts of the normal production process.
>
> (2) To study variations between different performances of the same process (different machines, different processing stations, or different days on the same machine)

sensitometric exposures are made on a reference emulsion (" check " or " type " emulsion) that is considered uniform throughout, and free of the gradual variations that normally occur with the passage of time.

Sensitometric processes will differ from production processes in several ways. For example, sensitometric processing machines can be smaller, and the smaller machine will permit the use of small quantities of processing solutions which can economically be discarded after each time of use so that the risk of lack of control through solution deterioration is reduced to a minimum. Furthermore, because of the small amounts involved, individual batches of dry chemicals used in making tank solutions will last a long time, whereas in production processes frequent changes from batch to batch are required.

Chemical Analysis.

Chemical analysis provides an important adjunct to the maintenance of a sensitometric process, and is of primary importance in checking the uniformity of raw chemicals and the making-up of processing solutions.

In establishing a sensitometric process, it is an obvious requirement that the process must closely approximate the production process normally used. Despite all precautions, it is often true that an exact match cannot be obtained between the results produced by the small control machine and those coming from the production machine. Even under such conditions, the sensitometric machine will still be a valuable tool, although the discrepancy from production results must always be borne in mind.

" Check " or " Standard " Emulsions.

Whenever it is necessary to determine processing characteristics, it is essential that stock variations shall not be added to the processing variations which are to be detected. Consequently a " check " or " standard " emulsion must be used—a uniform batch of film of the type under examination.

Photographic emulsions are not stable either in their unexposed or exposed state. Stability is improved by low temperature storage, but no practical conditions are known under which complete stability can be assumed. This means that a check emulsion will not remain constant indefinitely.

Secondly, the effect of an exposure on an emulsion does not remain constant for very long prior to processing. The latent image may grow, or it may decay. Thus the time which elapses between the exposure and processing of a sensitometric test must be carefully controlled.

Thirdly, no coating or batch of film is completely homogeneous, and variations do occur within the coating run. The presence of this form of variation can be discounted by using for each test a number of properly " randomized samples of the check emulsion coating."

To make the problem of process control still more complex, it must be recognised that even when sensitometric tests on check emulsion samples yield normal results, the process may still not be in control if one off-standard condition in the process (*e.g.* agitation) has been counteracted by a second off-standard condition (*e.g.* temperature). The danger of abstruse errors of this type can only be minimized by supplementary sensitometric tests with determination of temperatures, flow rates, and chemical concentrations.

IV—QUANTITATIVE EVALUATION OF THE IMAGE.

Colour densities can be divided according to geometrical properties of the densitometer :

Specular Densities.—The incident light is collimated. The receiver has a very small aperture accepting only undeviated light.

Diffuse Densities.—(*a*) The incident light is nearly collimated ; the receiver accepts all transmitted light, or (*b*) the incident light is diffuse ; the receiver has a small aperture.

Colour densities can be divided according to purpose :

Integral densities will be needed to determine the effects of absorption of an image upon a light beam reaching a positive print material or the eye of an observer.

Analytical densities will be used to determine the composition of an image in terms of the amounts of its component yellow, magenta and cyan dye densities.

Both forms of densitometry have important uses in colour sensitometry, integral densitometry measuring " performance " and analytical densitometry measuring " composition." For complete sensitometric description of an image, both types of measurement are necessary, but in practice both are seldom made, since through experience with a particular product correlations between performance and composition become sufficiently understood for one form of measurement to suffice for most purposes.

The response in a printing system is the formation of a latent image, and densities which describe the action of transparencies in decreasing this response are *printing densities*. The response in a viewing system is a visual response—the stimulation of colour receptors in the eye, and densities which govern this form of response are *colorimetric densities*.

If a densitometer is to evaluate the spectral transmittances of a transparency in exactly the same way as they would be evaluated by a printing material, the basic spectral response of the densitometer must be subjected to " spectrum weighting " functions, which in practice are usually approximations to theoretical requirements.

Arbitrary Three-Filter Densities.

A number of densitometers read an arbitrary form of integral colour density in which the colour responses are whatever the particular filters, photo-cells, etc., happen to give. These instruments are quite satisfactory for some purposes. In particular, they are satisfactory for comparing identical or nearly identical images, and much routine control work involves only this type of comparison.

Nevertheless, the limitations of such densitometers should be kept in mind. Density readings from such instruments cannot be safely used as direct indicators of printing density, or of image colour. Errors are particularly likely to occur in judging high densities. It is also not safe to compare a low density with a high density by means of such readings.

Spectral Densities.

" Spectral densities are those measured by light of a single wavelength."

Spectrophotometers will measure transmittances at any single wavelength, and from a series of such measurements a complete description of the absorption properties of an image can be obtained. The disadvantages associated with the use of such precise instruments as spectrophotometers are that too much time and labour are required in measurement and computation, and few spectrophotometers can measure the transmittance of the densest images used in colour sensitometry.

Equivalent Neutral Densities.

" The usefulness of the analytical density values can be greatly increased by selecting density units which give a better description of the integral image."

The unit generally used is called " grey equivalent density " or simply " equivalent density." Evans, one of the first workers to employ the term equivalent density, defined it as " the luminous density it would have if it were converted to a grey by superimpositioning the just required amounts of the other components of the process." The principal advantage of the equivalent neutral density unit is that three components which together make a grey must all have the same equivalent neutral density.

For materials intended to be printed rather than viewed, a unit called "equivalent neutral printing density" is sometimes used. This unit is necessary because a subtractive process grey is spectrally selective and its red, green and blue *printing* densities might be quite different, depending upon the part of the spectrum used in the printing process.

Systematic Errors.

A warning should be noted in connection with the use of analytical densities. It is really very difficult to determine the precise nature of each component subtractive image, since colour film images are not formed of *only* three absorbers, the cyan, magenta and yellow dye image ; there are also stains introduced during manufacture or processing of the sensitive material.

Because of this, most analysis procedures consider a fourth absorber to be present in the same amount in all images.

V—DENSITOMETER DESIGN.

The report makes it clear that while colour densitometer design and usage is still in an unsettled state, no preferred or recommended equipment will be indicated.

Current practice includes the use of three types of instruments. The first, and most common type, is a three-filter modification of a black-and-white densitometer as, for example, the Western Electric RA 1100 model. Provided that the width of the transmission bands of the filters is narrow and carefully chosen, colorimetric densities may be approximated. The Ansco colour densitometer uses very narrow cut filters and thus measures approximate spectral densities at the wave-lengths of the peak transmissions of the filters.

The second type of instrument, represented by the Beckman spectrophotometer and the General Electric recording spectrophotometer, measures true spectral densities at any desired wave-length. However, such instruments are not intended for use in routine densitometry.

Thirdly, there is the visual analytical densitometer, represented by the Evans instrument, which is calibrated to read in equivalent grey densities. With this type of instrument the colour wedges which are incorporated must match the absorption characteristics of the corresponding component dye in the film being measured, and consequently different sets of wedges are required for different colour processes. This same limitation applies to the Agfa photoelectric analytical densitometer.

Light Sources.

The primary requirement for a light source for any colour densitometer is that it must provide a sufficient quantity of light of the desired wavelengths. With many instruments it is also required that the output of the source must remain constant over long periods of time.

Tungsten lamps operated below their rated voltage will have an extremely constant output with a continuous spectrum suitable for most colour densitometers. The advantages of a mercury-cadmium lamp are that most of its luminous output is concentrated in isolated wavelengths, three of which are approximately centred in the three spectral regions generally required. The luminous efficiency of the mercury-cadmium arc is much greater than that of a tungsten lamp, and the problem of heat is therefore not so severe.

Filters.

"The simplest specification is to use any set of three filters of which each isolates somewhat less than one-third of the visible spectrum." The red, green, and blue light resulting from the use of such filters serves to establish integral densities which are peculiar to the particular densitometer. Despite this proviso, such arbitrary three-filter densities can be quite useful.

The filter problem is more serious when an instrument is required to measure printing densities or colorimetric densities. The selection of a combination of filters which will provide a reasonably close approximation to the required spectral properties is complicated by the fact that when the necessary filter cuts have been found, their efficiency may be so low that the sensitivity of the radiation receiver is insufficient to measure the transmitted light accurately.

The same type of problem is met in the selection of filters for making approximate spectral density measurements. The position of peak wavelengths for measurements of this type is at present under consideration by the Committee on Still Photography, Z38, of the American Standards Association. Whatever filters are used in a colour densitometer, they should be stable, and glass filters are recommended.

An alternative to filters can be obtained by using the spectral dispersion of a prism or diffraction grating, selected wavelengths being passed by slits in otherwise opaque masks. This kind of arrangement is usually found in spectrophotometers, which are generally capable of measuring the spectral density of an image at any or all wavelengths—in other words, the " complete and basic

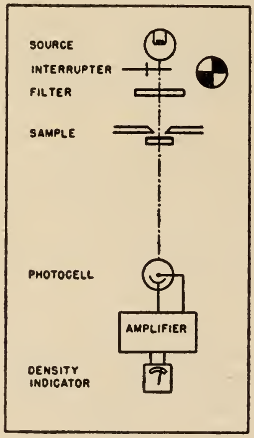

Fig. 1. Typical direct reading colour densitometer. The photo-cell output is used to measure the density of the sample.

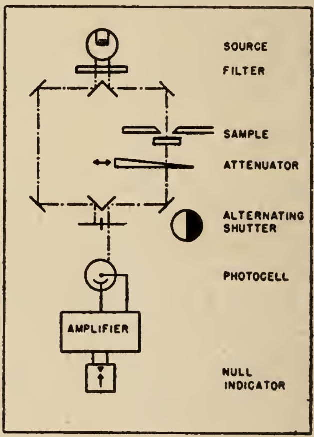

Fig. 2. Null reading densitometer. The photo-cell serves only to indicate balance between beams; the density of the sample is measured by the atttenuator.

description of the absorption properties of that image." Unfortunately the use of spectrophotometers is too complicated for routine application in sensitometry.

Wedges are mostly used in visual densitometers, the best known form being that found in the Capstaff-Purdy instrument for black-and-white film. Yellow, magenta and cyan wedges containing graded amounts of the dyes used in a particular colour process are used in the direct analytical densitometry of that process.

Receivers.

In the case of any visual densitometer, the receiver is the eye of the observer. Because of this it is very important to see that the observer suffers from no abnormality of colour vision. Even when the operator has normal colour perception, fatigue will tend to reduce the accuracy of his observations, and visual colour densitometers are not recommended for use where large numbers of test images must be examined.

Electronic receivers include many of the usual types of photo-cell and photo-multiplier tubes. Care must be taken to ensure that receivers which are sensitive to infra-red, or ultra-violet, receive nothing but those wavelengths which it is desired to utilize. A filter system to bring about such conditions will usually include an infra-red absorber, such as Corning 9780, or a liquid filter of cupric chloride solution.

Indicators.

Where the amplified response of the photo-electric cell is directly proportional to density, any ordinary electrical meter will show a deflection which is proportional to density, but when the output of the amplifier is proportional to transmission, the scale of a normal meter can be calibrated in terms of density only if the high density values are cramped at one end of the scale.

Special meters with non-linear movements, in which deflection is approximately proportional to the logarithm of the input signal, can be used. Such meters are generally used over a 10 : 1 signal range, and the densitometer will incorporate some electrical or optical attenuator so that densities within the ranges 0 to 1, 1 to 2, and 2 to 3 can be read by appropriate use of a range control.

Geometrical Design Factors,

Densitometers at present available show considerable variation in the " mode of illumination of the sample, and in the arrangement used to collect the trans-

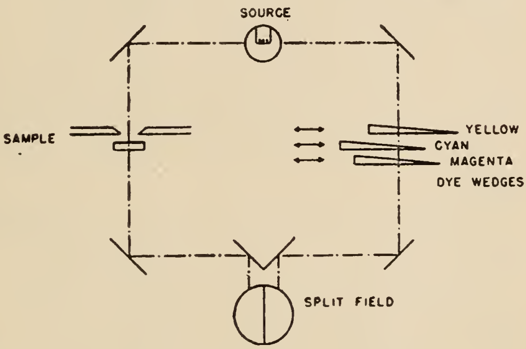

Fig. 3. Diagram showing the principle of an analytical colour densitometer.

mitted radiation." The only form of sample illumination that has yet been standardised is that which measures *diffuse* transmission density. (American Standard Z38.2.5.)

The fundamental difference between direct reading and null instruments is shown schematically. The primary output of a typical direct-reading colour densitometer (Fig. 1) may be an alternating signal produced by an intermittent (chopped) measuring beam. Following amplification and rectification, a d.c. signal is obtained that is proportional to transmission. When this signal is applied to a meter with a logarithmic scale, a deflection approximately proportional to density results. A photo-multiplier in conjunction with a special circuit has also been used to obtain a logarithmic output.

Equality of response in a null instrument is achieved by the calibrated reduction of the response from one of the beams, usually by means of silver wedges, polarising prisms, or variable apertures. As indicated in Fig. 2, the attenuator may be located in the same beam as the sample, in which case the sample and attenuator combine to reduce the response of the comparison beam until it matches that of the sample beam. In either case, densities are read from a scale connected with the attenuator.

Analytical Densitometry.

" The direct measurement of analytical densities is based on the principle that the absorption of the dyes in the film sample can be matched by the combined absorption of three wedges, each of which contains varying known amounts of one of the three dyes of the process in question."

A simple instrument of the type is indicated in Fig. 3. When the eye is used as detector, the two beams will be brought adjacent to each other in some form of split field optical system. The task of the observer is to adjust the three wedges until a colour match is obtained, when the position of the wedges will indicate either yellow, magenta and cyan analytical densities, or if the proper calibration has been made, the corresponding equivalent neutral densities.

With certain modifications and additions, the eye can be replaced by a photo-electric receiving system, as, for example, in the German colour densitometer described by Schneider and Berger.

The early visual analytical densitometer described by Evans is a null instrument in which the wedges are in the same beam as the sample and the comparison beam is constant. Additionally, the Evans instrument incorporates a silver wedge which can be used to replace a grey combination of wedge dye deposits, thereby reducing errors which can occur at high densities in dye wedges.

VI—TRANSFORMATION BETWEEN INTEGRAL AND ANALYTICAL DENSITIES.

Difficulties associated with the direct determination of analytical densities led to the possibility of calculating analytical densities from integral densities.

Spectral densities of yellow, magenta and cyan dye deposits, shown in the accompanying figure, represent a neutral grey image having a visual density of 1.00. The neutral appearance is the result of the combined effect of the three component dye images upon the light passing through the film ; at each wavelength, each dye acts independently of the others, and the total density at each wavelength is equal to the sum of the densities of the components. This total or " integral " spectral density is indicated by the upper " wavy " line in the diagram.

When the composite dye image is to be defined by integral spectral densities, three such densities at three different wavelengths in the regions of principal absorption of the three dyes, will be sufficient.

A denser dye image is represented in Fig. 5. In this sample, the yellow, magenta and cyan spectral densities, at 445 mμ, 535 mμ and 660 mμ respectively, have been increased to twice their value in the previous sample. However, largely because of the failure of the dye deposits to obey Beer's Law, the image which results is no longer exactly neutral, and neither does it have a visual density of exactly 2.00. Fortunately, in most photographic processes the departures from theoretical results can be considered too small to be serious.

The analytical dye densities indicated in the two figures can be expressed in various alternative ways. For example, in the two cases, the spectral analytical densities of the magenta deposits at 535 mμ are 0.76 and 1.52 respectively.

The yellow, magenta and cyan deposits shown in the first figure each have an equivalent neutral density of 1.00, because their superimposed absorptions result in a neutral grey of that density. It further follows that for the particular set of three dyes, a yellow deposit having an equivalent neutral density of 1.00, also has a spectral density of 0.66 at 445 mμ, while the yellow deposit indicated in the second figure has an equivalent neutral density of 2.00 and a spectral density of 2.00×0.66. Analagous relationships apply to the other two dyes of the set.

Integral Densities from Equivalent Neutral Densities.

When the equivalent neutral density of each component in a composite sample is known, an integral density curve can be obtained by multiplying the ordinates of the spectral density curve of each component by its respective equivalent neutral density and plotting the total of the resulting densities at each wavelength.

VII—INTERPRETATION OF SENSITOMETRIC RESULTS.

Since the interpretation of sensitometric tests involves purposes as well as facts, this is a more controversial aspect of the report than those already discussed.

Successful operation of a colour film process is usually accomplished in two stages. In the initial period of operation the process is intentionally changed after each trial run until the results are judged satisfactory. Once the aim point has been established, the objective will be to produce results repeatedly with minimum departure from this aim. The first stage will be called *adjustment*, and the second *control.*

Grey Scale Exposures.

A commonly accepted criterion for a colour process is that " a grey scale in the original scene should be reproduced as a similar grey scale in the final image, both with respect to colour balance and contrast."

In fact the imperfections of many processes are such that a more pleasing picture results when the overall contrast is greater than unity and, similarly, the most acceptable colour rendering may be achieved under conditions which

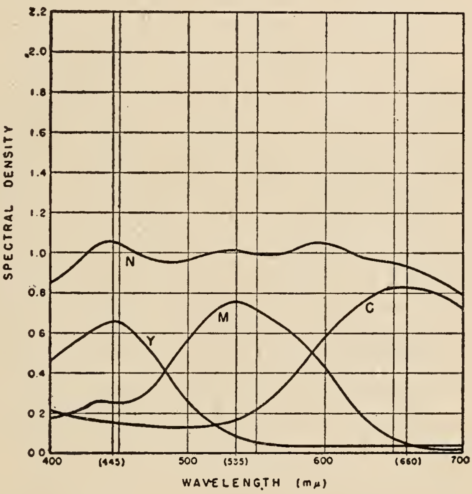

Fig. 4. Spectral densities of yellow (Y). magenta (M) and cyan (C) dye images obtained in a subtractive colour process. Superimposition of these images yields an image (N) that appears grey and has a visual density of 1.00.

do not result in a neutral reproduction of a grey scale. However, no successful process departs very far from the stated criterion, although the condition by itself is by no means sufficient for satisfactory reproduction—non-grey exposures also being an essential supplement.

With a process which reproduces grey subjects as approximately grey images, the contrast, density range and similar characteristics can be interpreted by the methods of black-and-white sensitometry. Although the individual steps of the grey scale reproduction may be close enough to neutral to serve for evaluation of luminous densities, in practice the colour of each step usually departs from grey, and the magnitude of such departures is obviously an important factor in the process. The rectification of such departures is one of the principal objects of process adjustment.

While it is important to supplement grey scale sensitometry with non-grey exposures, it must be realised that the accurate reproduction of highly saturated colours is beyond the capacity of present three-layer subtractive processes. Laboratories generally establish reference colour densities empirically, and the actual densities obtained during process adjustment are evaluated with respect to the reference densities.

The important qualities of a colour negative shown by a grey scale test are those that depend upon the gradients of the curves. The term " gamma " is seldom used in colour sensitometry since the curves produced rarely have straight line portions. Instead, " average gradient " is used, and this can be measured either by selecting a minimum and a maximum value of log E, which together define a region of particular interest, and determining the slope of the straight line joining the points on the characteristic curve corresponding to these exposures, or by selecting a minimum and a maximum density which define a density region of particular interest, and determining the stage of the straight line joining the points on the characteristic curve at which these density values occur.

Process Control.

Process adjustment ends when it is decided that the results will be acceptable without further modification. After this point, the operation of the process involves *control* ; the objective being to minimise all departures from the reference results.

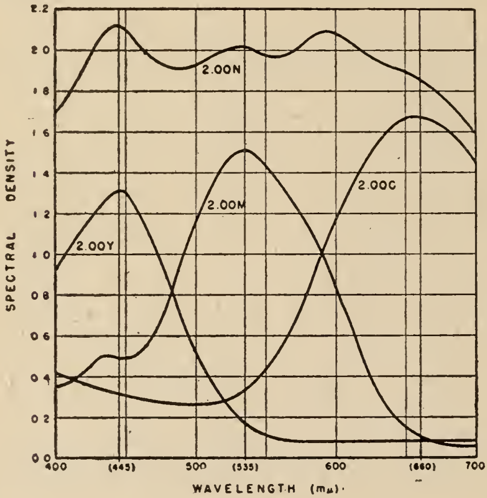

Fig. 5. Spectral densities of yellow, magenta and cyan dye images that have exactly twice the absorption of the images of Fig. 4. Superposition of these components produces an image whose spectral densities are exactly twice those of N in Fig. 4, but this image is not exactly neutral nor is its visual density exactly 2.00.

Colour sensitometry will serve to detect whether an earlier result is or is not repeated. In practice, exact repetition is rarely achieved, and frequently the measure of the departure is utilised as an indication of required corrective measures. It is controversial whether this is sound practice. Many operators prefer to depend upon primary measurements of the process variables.

Printer Adjustment Control.

Sensitometry has three important functions in printer operation :

(1) Specification of printer conditions required for a given negative to a precision sufficient to provide first approximations from which further corrections can be confidently predicted by picture judgments.

(2) Specification of printer changes to minimise differences among print film stocks.

(3) Specification of printer changes to produce a known desired effect.

Most of the sensitometry of *printer adjustment* will employ a camera exposed image of a grey scale on the negative material to be printed. A trial print should give sufficient sensitometric information for approximate corrections. The separations of the equivalent neutral density curves of the reproduction will indicate the corrections to be made in the relative exposures of the red, green and blue sensitive components.

In the absence of direct photometric measurements, *printer control* can be maintained by comparison of prints resulting from printer exposures made through a standard sensitometric scale negative with prints, simultaneously processed, resulting from sensitometer exposures. In other words, " the printer is controlled by reference to an unchanging sensitometer, with the print material as the comparison medium."

Batch to batch changes in print stock can best be evaluated from equivalent neutral densities.

Sound Track Evaluation.

In October, 1949, the S.M.P.E. Colour Committee voted to ask colour film manufacturers to determine which of the several available photo-tubes are best suited for sound reproduction on their particular products. " In the meantime, the interpretation of sound track sensitometric tests should be based on integral densities that accurately represent the spectral response characteristics of the particular type of sound reproducer with which the film is to be used." This will generally involve the use of a densitometer fitted with a photo-cell of the same type as that used in the sound reproducer.

VIII—STATISTICAL ASPECTS OF COLOUR SENSITOMETRY.

Precise determination cannot be made from a single sensitometric measurement because such measurements are always subject to random variations. Reliable conclusions can be drawn, however, from series of experiments interpreted by statistical methods, and " the purpose of this section is simply to call attention to this new and important phase of colour sensitometry."

When several duplicate exposures are made on a small sample of photographic material, and the group is processed together under carefully controlled conditions, and then measured on a correctly adjusted densitometer, the individual images will not have identical densities. If the sensitometric test procedure is well controlled, these density variations will represent random variations for which no specific causes can be assigned.

An important problem of colour sensitometry is the evaluation of such systematic differences from data which contain the random variations.

Individual Sources of Variation.

Densitometer variation can be determined by measuring the same processed strip on several densitometers. Sensitometer variation cannot be isolated on finished strips, but photometric methods can be used to check the magnitude of any variation.

There is no completely satisfactory way in which film or processing variations can be separately determined. The best that can be done is to study one of the variables under conditions that make the remaining variables relatively small.

Statistical Methods of Data Presentation.

Statistical methods can be used to present and interpret experimental results in colour sensitometry. For example, frequency diagrams (histograms) are useful in studying the results of large scale experiments ; they are preferable to tables because they convey a graphic picture.

Similarly, the order or time sequence in which a set of results was obtained can best be shown in the form of a control chart.

REFERENCES.

A comprehensive list of thirty-four references concludes and greatly enhances the value of the report.

ELECTRICAL DEVICES AS APPLIED TO SPECIAL EFFECTS

Presented to a joint meeting of the British Kinematograph Society and the Association of Cinematograph and Allied Technicians, on March 29, 1950.

I — PROBLEMS OF REMOTE CONTROL

John Gow*

THE Special Effects department at Pinewood Studios has in the past consisted of four sections : the matte, miniature, process projection and stage effects departments, and each of these departments calls for electrical devices. In the main, problems involve the motorisation of a moving unit, such as small models, revolving globes, moving glasses.

In stage effects, the opportunities give more scope to ingenuity, and permanent pieces of equipment have been evolved, each utilising electrical power of some kind or another, such as fog generators, rain machines and weapons of all kinds.

Control of Process Projectors.

In the field of process projection, we have utilised electrical power, other than the normal direct current which supplies the arc, to assist production. During the last few years, projectors have changed quite appreciably, and we now see a complex use of small electrical units incorporated to assist in speeding up production and to produce effects hitherto only dreamed about.

As arc lamps have increased in light output, heat has also increased, and it has become necessary to remove some of this heat in order to keep the film or slide in a reasonable condition, and to safeguard the glass lenses incorporated. This has been achieved by the introduction of an ON 20 glass which absorbs some of the unwanted heat, and removing this heat by circulating cold water over its surface ; the water also cools the No. 1 condenser at the same time. The water is kept circulating by the use of a pump driven by an electric motor.[1]

At the output end of the projector we have the lens, and this has been mounted in a cradle which will move in three directions, each of these movements electrically controlled, and from a remote distance. To achieve this, Selsyn motors have been used, and from a master motor at the camera position, a slave motor attached to the lens mount is made to operate. The principle was used during the war for controlling guns from a remote distance. We now can, from the camera position, obtain focus, rise and fall of pictures on the screen and also horizontal movements.[2]

In the still process projector, accuracy of registration is often necessary between background and the foreground set. On the latest equipment, no fewer than six movements are controlled by means of Selsyn or Magslip motors from the camera position : focus, vertical and lateral centring of the picture, and vertical, horizontal and circular movement of the picture. The size of slide has been increased to 5 ins. × 4 ins., permitting it to be traversed for effects such as clouds.[3]

Recording Camera Movement.

These small and efficient motor units can be, and are being, used for other purposes of remote control, and can be utilised for remote camera focus or camera movement when necessary.[4]

We are at the moment developing a slave head for use with the travelling matte process, the idea being that any movement of camera on the foreground action is recorded and the movement duplicated when shooting the background,

* J. Arthur Rank Productions, Ltd.

so that both when superimposed have identical movements ; unfortunately we are unable to disclose details at the moment.[5]

Power-driven models are in constant demand, and model trains, cars, buses, etc., are standard practice. Each model has its own problems : steering, illumination, or as on a model electric train we used recently, the sparks from the shoe contacting the live rail.

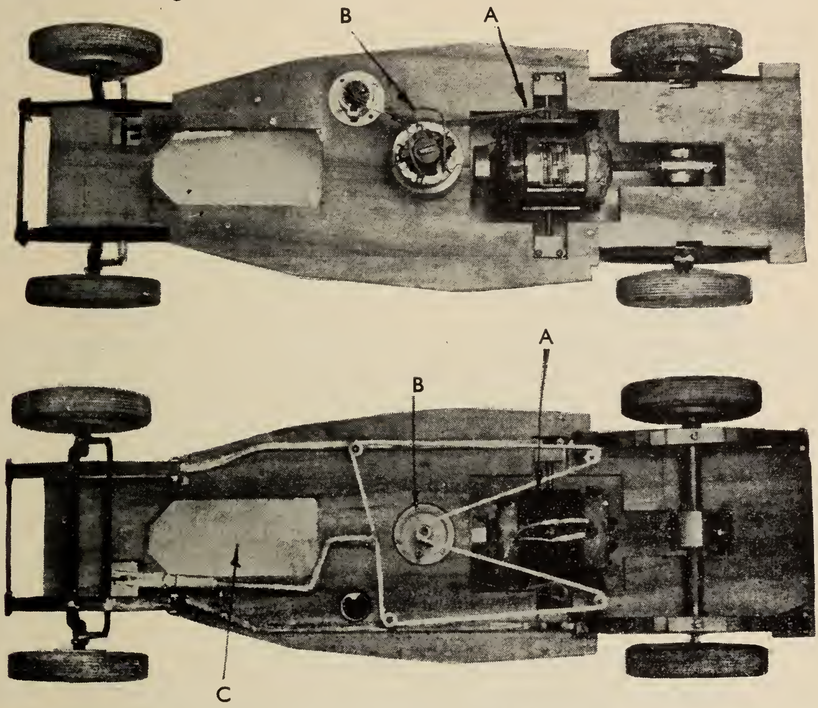

Fig. I. Plan and underside views of Model Motor-car Chassis.
A, Driving Motor. B, Selsyn Motor controlling Steering. C, place for Pencil Arc.

Other uses of electrical power by this department have been many, but perhaps one will be of especial interest : the use of ultra-violet radiation. This was used in the ghost sequence in "Hamlet." The radiation from an ultra-violet lamp is almost invisible to the human eye, but the fluorescence of suitable substances is actinic, and objects in a darkened room can be illuminated by switching on an ultra-violet lamp.

II — MISCELLANEOUS EQUIPMENT.

Frank George*

Mr. George demonstrated the following pieces of equipment :

I. Miniature Fog Generator.

The method used in the production of artificial fog was to heat diesel oil to the point of vaporisation ; if it were made too hot, blue smoke was produced. There were obvious difficulties in maintaining a constant temperature of 650° to 700° F. ; gas would be a suitable medium but for the problems of portability, and the source used was therefore electricity.

* J. Arthur Rank Productions Ltd.

In the instrument demonstrated, a 230v. 1 kw. electric fire element was operated from the 115v. supply ; the wattage was thereby reduced to about 250. The element was covered externally with fire-clay to insulate it from the steel tube coil, and was further lagged with asbestos, so that it retained its heat for a considerable period after being switched off. It took approximately ten minutes to reach operating temperature, and could then be left for long periods without fear of overheating, since it took nearly an hour to reach dull red heat.

Diesel oil was sprayed by pressure from a bottle of carbon dioxide. A demonstration of the device proved it to be capable of projecting a stream of fog half-way

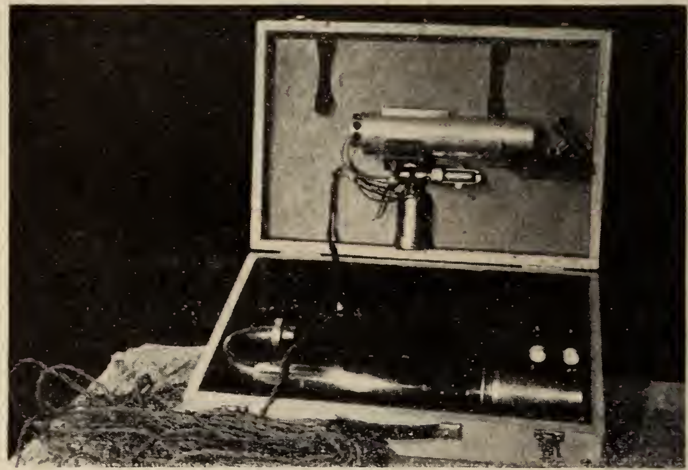

Fig. 2. Portable Fog Generator.

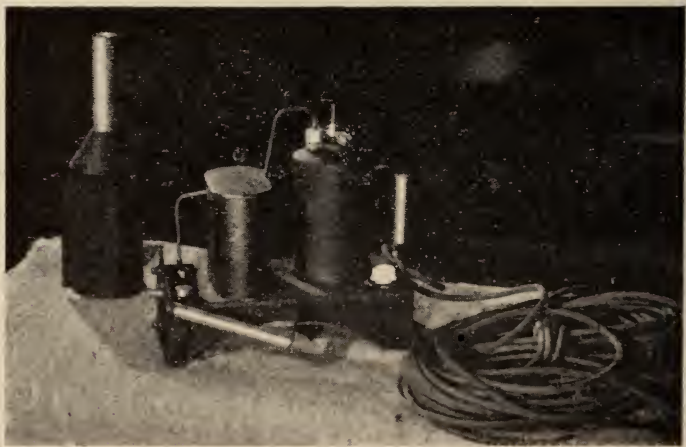

Fig. 3. Large Fog Generator.

down the hall. Where a greater quantity of fog was required, a larger generator was needed ; the speaker explained two types, both working on the same principle as that demonstrated. By means of solid carbon dioxide, kept at a temperature of —72° C., the fog was caused to sink, producing realistic effects.

2. Flicker Device.

A flicker device for simulating firelight has been previously described. A similar system had been constructed by the Sound Department at Denham

Studios ; it consisted of a photo-cell which controlled a thyratron, the latter having a capacity of 2 kw. The photo-cell was exposed to the light of the practical fire, and controlled lighting units in sympathy with the flames.

A difficulty was, however, that lamps of over 250 watts had sufficient thermal inertia to reduce the intensity of flicker. Up to eight 250-watt lamps could be used to produce a flicker effect, all of course controlled by the same input signal, and therefore flickering simultaneously.

An improvement in this device would be to provide several separate channels, each controlled from differently placed photo-cells, thus creating a much more realistic effect.

3. Gun Flashes.

To produce the illusion of the flashes from the muzzle of a gun, oxy-acetylene was ignited by means of a spark. The spark was generated by an ordinary car ignition coil, and the speed of firing was determined by a contact breaker and distributor, driven by a small motor. The trigger of the gun broke the low-tension circuit, or it could be operated from the motor control box.

The colour of the flame could be controlled by varying the proportions of

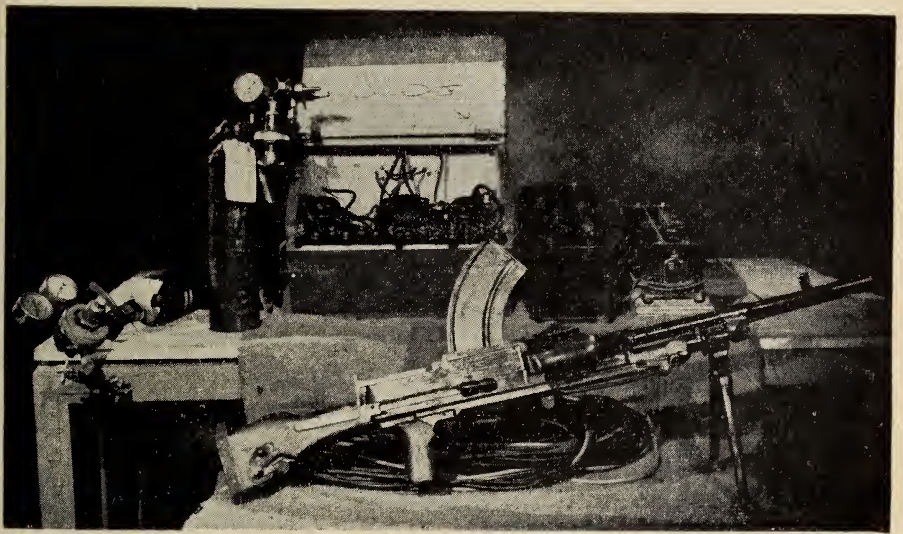

Fig. 4. Gun-flash Device, fitted to Bren Gun.

gas, and if a very yellow flame were desired, this could be achieved by inserting a small quantity of common salt into the gun muzzle.

Adjusting the gas cylinders to produce the required mixture, the speaker demonstrated the results, with quite startling effects, since both noise and flash were most realistic. The system had, he added, been used for all types of guns, up to naval cannon.

4. Synchronised Shutter for Back-projection.

The synchronised shutter as an aid to cameramen was developed to assist in balancing foreground lighting for back-projection. The apparatus consisted of a single aperture shutter, driven in synchronism from the projector interlock system. The shutter was intended to be mounted on the view-finder, thereby producing the same degree of flicker over the whole scene when viewed from the camera.

The shutter could alternatively be mounted to view the set-up under running conditions, but without the reduction of size due to the view-finder. In either case, the foreground and background were seen as an intermittently lit scene, instead of a constantly lit foreground and an intermittently lit background. The cameraman was thus assisted in securing perfect balance of lighting.

5. Automatic Water Sprinkler.

This had been designed for the purpose of supplying a silent rain supply when production necessitated a direct recording, the normal supply being impracticable under such circumstances. The machine consisted of a rotating sprinkler which was filled from an external supply pipe. The machine was silent in operation because all air was ejected from the sprinkler. The intensity or size of the rain drops was governed by the size of the perforation in the sprinkler, floor coverage by the speed of the rotation of the sprinkler.

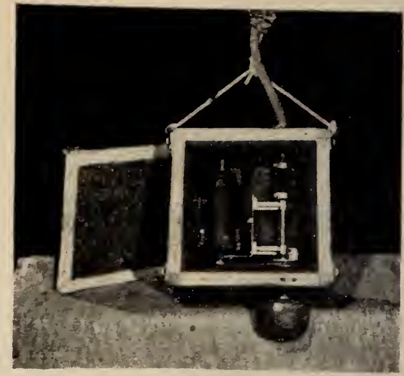

Fig. 5. Noiseless Water Sprinkler.

REFERENCES

1. *Brit. Kine.*, **16**, No. 2, February, 1950, p. 38.
2. *Brit. Kine.*, **17**, No. 1, July, 1950, p. 5.
3. To be described later in this Journal.
4. *Brit. Kine.*, **15**, No. 3, September, 1949, p. 75.
5. *J. Soc. Mot. Pic. Eng.*, **48**, No. 4, April, 1947, p. 353.

DISCUSSION

Mr. R. H. Cricks : A fault often seen, even in features, is that of wheels standing still or turning backwards. If the flicker-type view-finder were used on such scenes, the cameraman would be able to avoid such stroboscopic effects by adjusting the speed of the wheel.

Mr. George : Yes, the cameraman would be able to see the effect and slow down or speed up the wheel.

A Visitor : Is anything being done in the way of automatic focus ?

Mr. George : Yes, we have used it on a model. We had a shot in " Uncle Silas " where we had a 27-ft. model with forced perspective, the focusing point being on a door. The camera had to track from one end to the other, holding the door in focus during a 27-ft. travel down to 9 ins. We used a Magslip generator and a slave motor. Unfortunately the movement of the lens is not linear, consequently it would mean a rather involved form of cam ; therefore the master generator was operated by hand.

Mr. G. Hill : Automatic focus would be extremely useful even in normal fixed shots. It has been used for years on model and trick work, but unless you can get the artistes to hit the particular spot every time, it is difficult to operate.

A Visitor : Why was the Selsyn put on the lens of the projector to line the picture up ? Why not on the projector itself ?

Mr. Gow : The lens has been designed in such a way that it will cover the movement in three directions.

Mr. Benson : Needing a fog machine on location where there was no power, we used a baby Calor.

Mr. George : You can get almost the same effect with smoke powder, or with a special candle which I have recently obtained from Germany.

Mr. W. S. Bland : With regard to the flicker shutter, I wondered whether you could get over the difficulty by having a different shutter for lining up, with the flicker blade on it arranged to pass the same amount of light. The cameraman would not then be conscious of the flicker in his background.

Mr. George : The projector shutter usually has a similar opening to the camera shutter. With the ordinary projector you could afford to do that, because the pull-down period is less than 90°.

Mr. Bland : With regard to the thyratron-operated photo-floods for flicker effects, it would be simpler if you recorded the effect of the flicker from the original photo-cells upon magnetic tracks, and then had the pick-ups lined up so that the half-dozen bits of flicker were fed to the photo-floods. You could have a loop of tape.

Mr. George : We have invariably to put a practical fire in the set, and we use the actual flames.

Mr. Bland : The trouble with the use of moving slides for background skies is that clouds moving across the sky never move in constant relation one to another.

Mr. Gow : We have found that the use of two or three glasses moving against one another gives a very realistic effect.

Mr. Benson : Have the authors found any way of strengthening soap bubbles ?

Mr. Pearson : I shall be pleased to assist the speaker. I have had bubbles which travelled as much as 200 feet.

STAGE, FILM AND TELEVISION COMPARED

Peter Bax*

Summary of lecture given to a joint meeting of the British Kinematograph Society and the Television Society on March 1, 1950. The paper will be printed in extenso in the journal of the latter Society.

MR. BAX first differentiated between the stage, where the audience was present at the time of the performance ; television, where the audience was not present, but saw the performance simultaneously ; and the film, where the audience was remote in time and space from the actor.

The evolution of places of entertainment from the prehistoric gatherings around the communal fire, to the modern theatre and kinema, was briefly described.

From the early mysteries of the temple, Mr. Bax turned to the Greek theatre, where drama was developed to a very advanced state. The introduction of the actor had occurred about the fifth century B.C., when an obscure character called Thespis played individual rôles, as distinct from the Grecian chorus. Sophocles introduced special costumes and masks.

Later, the Greek stage had employed scenery and used a proscenium. But the proscenium was first a painted back-cloth, then an arch at the back of the stage, and only later between the stage and the auditorium. A device used for changing scenery consisted of rotatable prisms, each face carrying a different scene.

The Evolution of the Stage

The origin of the auditorium was, of course, the open-air amphitheatre, the audience seated on the slopes. The theatre at Athens, built in such a way, seated 20,000 to 30,000 people. At first the stage was merely the bowl of the amphitheatre, below the level of the audience, but gradually it rose in height. The orchestra was originally a large depressed stage. It was, said the speaker, still possible to stand in the orchestra of a ruined Greek theatre and get the sensation of being at the base of a funnel, with tiers of seats rising around one. An immense effort of will must have been necessary for a Greek player to put across his personality ; he was assisted by megaphones and possibly by stilted shoes.

The Romans decided that the Greek theatre was too serious. Immensely extravagant shows lowered the standard of production. The box-office had appeared and the playwright had lost control.

After the decline of the Roman Empire, the theatre in Europe survived in the form of local festivals, and later in mystery plays. By the twelfth century strolling players appeared in this country, presenting their performance on wagons in the street. To Shakespeare, such performances were a living memory. At the time of Elizabethan renaissance, players acted in the courtyards of inns.

At the Restoration, foreign actors came over to this country and revived the Greek proscenium, which kept the audience in front of the actors, instead of all around them. Before this the actor had had to declaim his words, but when the proscenium frame was introduced he had only to speak in one direction. The technique of the actor became substantially the same as in the modern film.

The Birth of the Film

The entertainment film had started with stories of crime. As early as 1904, the flash-back had been used in a film which employed also double-exposure. At this early period, Méliès was exploiting every stage artifice before the camera.

The early film actors came from the stage. The progress of the film was, however, beset with difficulties, and it got a showing only in the music-halls—

* B.B.C. Television Service.

(Courtesy of British Broadcasting Corporation)

Photograph of the television production of "Rebecca" and, below, a scene from the London stage production.

it became an interlude during which patrons repaired to the bar. Just before the first World War, " Electric Palaces " sprang up, their prices sometimes as low as one penny. In distinction to the early development of the theatre, the box-office was pre-eminent from the beginning.

Later came sound. For a period, films made originally as silent films were fitted with sound tracks. The film makers found that it was quite possible to synthesise a film star from a girl's looks and a director's brains.

The Experiment of Television

In 1936, stage, film and radio were thrown together at Alexandra Palace. Television had one great asset : it could show events as they happened. Like the stage, its actors must learn their lines and build up their parts ; the scenery must be as cheap as that of the stage, but look as solid as that of the film. Retakes and editing were not possible. Finally it must always be borne in mind that television went into the home like sound radio.

How could television compare with the stage, with its two-way contact between actors and audience ? With the film, with its slow and careful elimination of errors and final grooming ?

Television, concluded the speaker, must develop along different lines from either. Things that would appeal on the stage would not appeal to the viewer at his fireside. Television must develop its own type of entertainment.

(Courtesy of Angus McBean and H. M. Tennent Productions Ltd.)

TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

BLANK FILM

W. Lantsch, *Foto-Kino-Technik*, January, 1950, p. 12.

A plant for the manufacture of film base is described, having an output of a million square metres a year. The base is cast upon an endless belt, and after drying, sub-stratum is applied before the base is cut to length and wound. R. H. C.

COLOUR MEASUREMENT OF MOTION PICTURE SCREEN ILLUMINATION

R. E. Harrington and F. T. Bowditch, *J. Soc. Mot. Pic. & Tel. Eng.*, January, 1950, p. 63.

For a full comparison of the colour quality of motion picture projector light sources, the complete specification of the spectral distribution of the radiant energy is required. High intensity carbon arc sources, however, are shown to be a sufficiently close approximation to black body radiators in the visible part of the spectrum for the colour temperature to be a useful means of assessing colour quality. Measurements of chromaticity co-ordinates and spectral energy distributions are given to illustrate this point. A method of making direct colour measurements on the arc crater from various angles of view and of combining these measurements to give the colour of the light, is described. F. S. H.

A NEW TECHNIQUE FOR THE PRODUCTION OF 16-mm. SOUND PRINTS

Tech. Ciné., January, 1950, p. 25.

The Debrie Tipro sound reduction printer employs 32mm. stock, upon which two sound tracks are produced, each track a twin image of the 35mm. track, so avoiding the use of anamorphotic systems. (See *Brit. Kine.*, **17**, No. 1, July, 1950, p. 13.) R. H. C.

NEW PROJECTION LAMP AND CARBON-FEED MECHANISM

J. K. Elderkin, *J. Soc. Mot. Pic. & Tel. Eng.*, January, 1950, p. 87.

A feed system for a projection arc employs a separate A.C. motor for each carbon, each motor intermittently energised by means of an electronic impulse generator, and the rate of feed being thus independent of arc voltage. R. H. C.

INDUSTRIAL SAPPHIRE IN MOTION PICTURE EQUIPMENT

W. Bach and C. Wagner, *J. Soc. Mot. Pic. & Tel. Eng.*, January, 1950, p. 95.

Industrial sapphire is an artificially grown crystal, made in rods up to ¼ in., and in boules up to ¾ in. diameter. This paper draws attention to possible uses, in particular for components subject to film wear. R. H. C.

THE IMAGE ISOCON

Paul K. Weimer. *RCA Review*, September, 1949, p. 366.

Yet another picture pick-up tube for television is described in this article from the RCA Laboratories. This new tube is experimental, the object being to produce television pictures in which the signal-noise ratio is improved in the black portions of the picture.

This is a desirable feature for American stations which use image orthicons exclusively as camera tubes, since these exhibit this defect under certain conditions. T. M. C. L.

TELEVISION STUDIO LIGHTING

A. H. Brolly, *J. Soc. Mot. Pic. Eng.*, December, 1949, p. 611.

LIGHTING DISTORTION IN TELEVISION

Richard Blount, *Ibid.*, p. 625.

These papers should be read by all interested in lighting, particularly for television sets. The authors are practical men with many years experience of running a television station.

The lighting set-up and filters are intended to give good colour response for image orthicon cameras and we, in England, must remember that there are differences with the various types of English camera tubes. T. M. C. L.

PERCEPTION OF TELEVISION RANDOM NOISE

Pierre Mertz, *J. Soc. Mot. Pic. & Tel. Eng.*, January, 1950, p. 8.

This is a mathematical article analysing the effects of " noise " as being analogous to grain in photography. The effect of noise on contrast of the television picture is also analysed. T. M. C. L.

PRESENTATION OF 16mm. FILMS

At the request of organisations interested in raising and maintaining the standard of 16mm. technique throughout the industry, the Society has set up a Committee of Investigation. This Committee will investigate and report current methods and practice and will subsequently issue a code of recommended practice to the industry generally.

The parent Committee, under the chairmanship of Norman Leevers, B.Sc., A.C.G.I., will operate through four technical sub-committees, each dealing with a separate branch of the work, as follows :

Photographic Sub-Committee : To be appointed.

Sound Recording Sub-Committee : N. Leevers, B.Sc., A.C.G.I. (*Chairman*), R. A. Ball, C. C. Buckle, P. Heath, M. V. Hoare, A. Tutchings.

Projection Equipment Sub-Committee : W. Rudd (*Chairman*), L. S. Baker, D. S. Morfey, N. W. Wooderson.

Presentation Sub-Committee : H. S. Hind, A.M.I.E.E. (*Chairman*), L. S. Baker, J. W. Hissey, M. Raymond.

The work of these sub-committees will include consideration of the items set out below :

Photographic Sub-Committee :

1. Picture contrast.
2. Picture density.
3. Definition.
4. Methods of picture duplication.
5. Methods of sound duplication.
6. Track density and fog level.
7. Flutter in printing.
8. Printing light sources.
9. Negative wear in printing.
10. Methods of using joined stock.

Sound Recording Sub-Committee :

1. Frequency characteristics.
2. Recording levels.
3. Volume range.
4. Recommendations for colour processes.
5. Distortion content.

Projection Equipment Sub-Committee :

1. Wear or damage to film : Perforation damage, Abrasion, Heating.
2. Picture steadiness.
3. Illuminant : Optical efficiency, Effective light output, Lamp life (incandescent sources only).
4. Sound head : Speed stability, Optical efficiency.
5. Mechanical sturdiness.
6. Ease of maintenance.

Presentation Sub-Committee :

1. Routine testing.
2. Test films.
3. Adjustments.
4. Available spares.
5. Projector speed.
6. Methods of storage.
7. Joining of reels.
8. Assembly of continuous programmes.
9. Position of projector.
10. Size and position of screen and surround.
11. Screen illumination.
12. Ambient light level ; loud speaker position ; sound volume level ; acoustic conditions.
13. Care of films.

It has been resolved that the investigation be as complete as possible, and that it be carried out impartially and in a way which will not embarrass users of current processes, since the aim is to influence future development into the most suitable channels.

The work itself will resolve into two stages :

Stage 1 : The examination and criticism of present practice.

Stage 2 : The specification of methods for obtaining the best results.

It is expected that the first stage will be completed by early Spring, 1951, and the second stage will follow later in the year. The Committee welcomes the support and active collaboration of those in the industry who are in a position to assist by the contribution of helpful information or in other ways, and feels confident that this investigation will ultimately be of great value in stabilising and promoting the healthy growth of the 16mm. film industry.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library

DEEP FOCUS AND LONGER TAKES

The Garutso lens provides additional depth of field at a given aperture. (According to the *Cine-technician*, July-August, 1950, p. 106, it consists of an annular element attached to the normal lens.) *Amer. Cine.*, September, 1949, July, 1950.

DEPTH BY INSPACIAN

Improved depth of field is achieved by means of a device which causes consecutive frames of film to be focused on different planes. *Inter. Phot.*, August, 1950, p. 8.

REALISM WITH A MASTER'S TOUCH

A large proportion of the film " Asphalt Jungle " is being filmed with a 35mm. lens, in order to achieve depth of field. *Amer. Cine.*, August, 1950, p. 271.

"LIGHT MEASUREMENT FOR EXPOSURE CONTROL"

Arising out of a paper by Captain Don Norwood under the above title in the May, 1950, issue of the *Journal of the Society of Motion Picture and Television Engineers*, Mr. J. F. Dunn has addressed a communication to the Editor of that Journal, of which the following is an abridgement :—

" I wish briefly to take exception to Mr. Norwood's statement on p. 595, in which he claims that 'his concept of *Effective Illumination*, which takes into account illumination intensity and relative positions of observer, subject and light source *has not heretofore been crystallized or formulated*' (the latter italics are mine). In contradiction to this statement, reference may be made to the November, 1948, *British Kinematography* containing my article 'Exposure Technique for Reversal Materials,' from which it may be noted that I described this effect (which I named the 'Duplex' technique) over two years ago before a meeting of the British Kinematograph Society in London.

" Since reading my paper in 1948, a slight improvement over my originally described 'Horizontal Duplex' method has been developed. The new recommended 'Direct Duplex' method, which has been worked out by my colleague L. C. Walshe and myself, still consists of taking two readings with an incident light meter (of the flat window type), namely a 'camera direction' reading (as previously recommended) and a 'major source direction' reading (as originally recommended for use alone by P. C. Smethurst, who first introduced the incident light meter technique in England in 1936—see his paper in *Journal of the British Kinematograph Society*, Vol. 1, No. 1, December, 1937).

" The required exposure for average work is then given by simply taking the geometric mean of the two Duplex readings, *i.e.*, the mid point on the stop scale between the two readings. For clear-cut conditions this technique will be found to line up almost exactly with the exposure levels recommended by the principal reversal colour film manufacturers, and it has proved to be highly successful in practice. It has, incidentally, already been fully described in a book on this subject which is in preparation and will be published in due course."

Captain Norwood, in a reply to the Editor of the *Journal of the S.M.P. & T.E.* (a copy of which was kindly addressed to the Editor of *British Kinematography*) mentions that his experience with incident light meters dates from 1933, and cites the following U.S. patents : Nos. 2,214,283, 2,489,664 and 2,444,464. He continues :

" It has been recognised that some workers in this field have had a more or less hazy realization that more was involved in incident light measurement for exposure control than a simple measurement of light intensity. Various corrective expedients have been proposed by some of these workers, such as pointing a meter with a plane surface light collector toward the camera from subject's position ; pointing said meter toward principal light source ; aiming said meter towards a point half way between said light source and said camera ; pointing meter at camera and at light source in turn and using a mean reading as suggested by Mr. Dunn. However, none of these makeshift methods appears to indicate a full and clear-cut realization of the basic principles involved in the matter. None of the experimenters has, to my knowledge, brought forth precise and comprehensive formulas such as those shown in (15) and (16) on p. 595 of the May *Journal.*

" I do not agree that Mr. Dunn in describing his Duplex Method in *British Kinematography* has given a clear-cut, well crystallized comprehension of all the factors involved, as well as a formula for accurate solution of the problem. For instance, his formula for calibration of incident light meters was preceded by a quite similar formula on p. 14-16 of the *I.E.S. Lighting Handbook*, published in 1947. Neither formula takes into account the vital factor of geometrical relationship of subject, camera and light source. If this relationship were understood it would seem that it would have been put into Mr. Dunn's formula.

" It is of interest to examine under specific conditions Mr. Dunn's recommended method of operation. As an example, we find that Mr. Dunn's Direct Duplex Method would give identical exposure control settings for a *cross-lighted* arrangement (90° keylight angle), and a *back-lighted* arrangement (135° keylight angle), where other factors remain constant. Reference to instructions issued by leading colour film manufacturers (see Note 5, my paper) will show that a considerable difference in exposure control setting is recommended for *cross-lighted* and *back-lighted* conditions. The difference is usually about one *f*-stop. It is generally believed that reversal colour film will not tolerate an error of one *f*-stop. Therefore Mr. Dunn's 'two-readings' method when used with colour film under the common conditions described above will give errors which lie outside the acceptance latitude of the film. This also negates Mr. Dunn's statement (next to last paragraph in his letter) that his method lines up with recommendations of film manufacturers."

In a rejoinder Mr. Dunn emphasises that he had no intention of depreciating the work of Captain Norwood ; the calibration equation given in his original paper was not claimed as novel. He continues :

" Though a full range subject illuminated by front or flat lighting just about lines up

with the reproduction range of reversal colour materials, this is quite definitely not the case where cross or back lighting is employed. Thus in the latter case particularly, the total subject range far exceeds that of the film and the exposure must necessarily be very much of a compromise.

"What actually happens is that the first 'normal to source' reading on the one hand correctly reproduces the fringe headlights of such subjects, but under-exposes the darker shadows whereas, on the other hand, the 'camera direction' reading correctly exposes the darker shadows facing the camera, but burns out the highlights. Thus any Duplex 'in between' compromise obviously falls in between the above extremes, and the particular 'geometric mean' suggested by us for normal use actually splits the errors equally on each side, thus giving, in our view, the best compromise for the general case.

"It is admitted that a slight difficulty arises with 90° lighting when taking the camera direction reading, but even this rarely applying condition is easily overcome by swinging the meter a few degrees either way into and out of the sun and taking the mean of the indication as the 'camera direction' reading. The 'normal to source' reading followed by the 'mid point' compromise is then applied, as in the case of any other lighting condition. There are, of course, also other exceptions covering 'all light' and 'all dark' subjects for which corrections need applying and which can hardly be avoided irrespective of the method of approach."

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.

CHARLES H. CHAMPION, M.I.Mech.E., A.M.I.E.E., F.B.K.S., F.R.P.S.

Died August 30, 1950

Mr. Champion, who died whilst on holiday in Belgium, was chairman of Charles H. Champion & Co. Ltd., and The Ship Carbon Co. of Great Britain Ltd., besides being a member of many learned Societies and one of the original Fellows of the British Kinematograph Society.

He founded Charles H. Champion & Co. Ltd., in 1922 and introduced Ship Carbons to this market. Subsequently, in 1927, he founded the Ship Carbon Co., and established a producing unit for lighting carbons in this country. He devoted his entire efforts to building up the lighting carbon industry here, and Ship Carbons are a great monument to all that he did.

During his career, Mr. Champion became very keen on better projection, and supported the projectionists in their efforts to obtain better picture presentation. Many members of the late Guild of Projectionists will well remember his efforts in this direction. He also was very interested in all the Society's work, being a member of the Council for many years, and lent his influence towards making the Theatre Division of the Society a success.

Mr. Champion was courteous and charming in his manner, and the industry has lost a man it could ill afford to lose.

H.C.S.

NOTICE

It is desired to get into touch with the following members. Please contact the Secretary, 117 Piccadilly, W.1.

E. M. Askew.
P. N. Bishop.
A. E. Davis.
M. P. Rowland.
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LIBRARY

The Librarian will be pleased to send books by post on receipt of a request.

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

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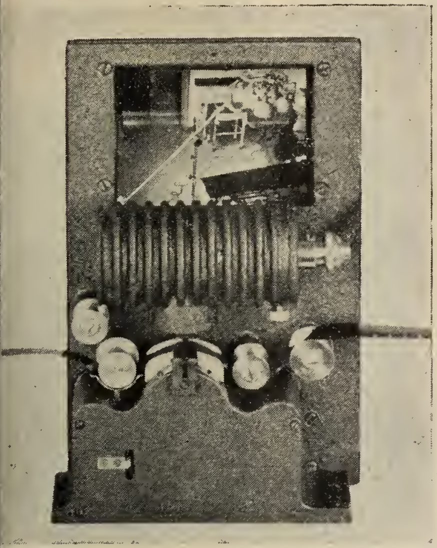

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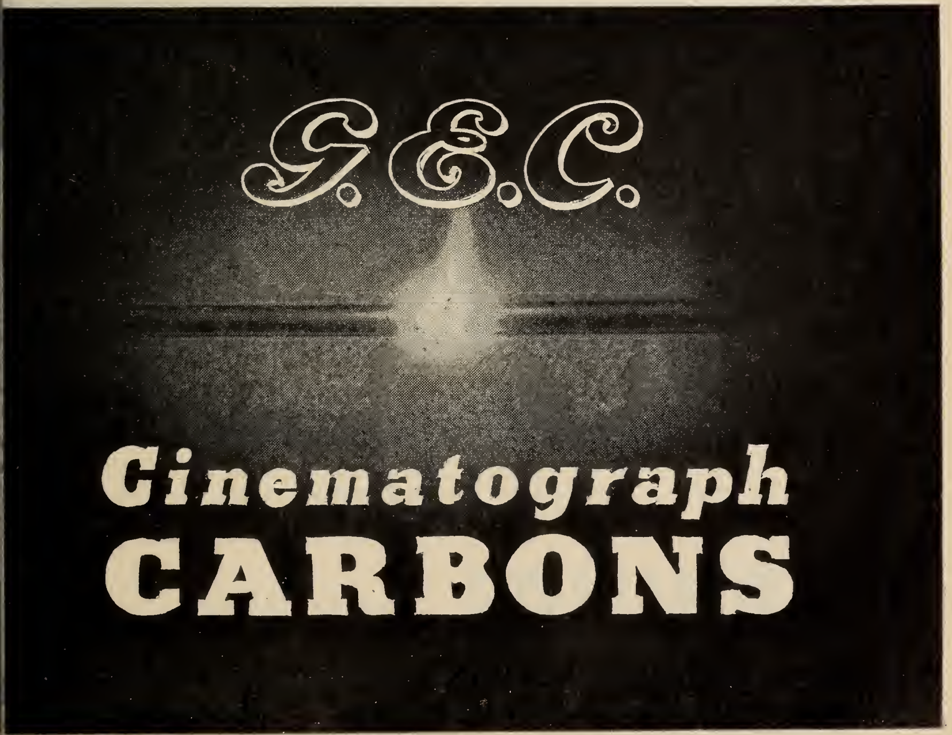

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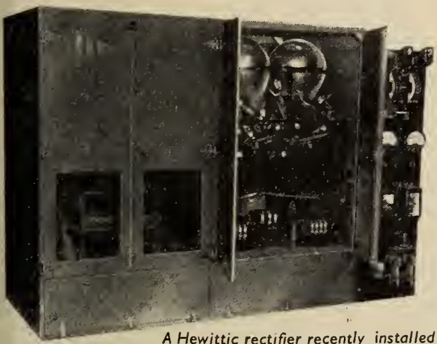

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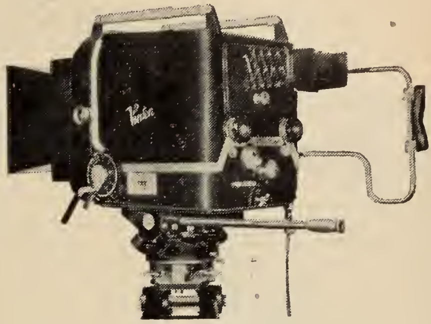

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SEVENTEEN, No. 4 OCTOBER, 1950

MOTION PICTURE CAMERA DEVELOPMENT

George Hill*

Read to a joint meeting of the British Kinematograph Society and the Association of Cinematograph & Allied Technicians on April 19, 1950.

THE history of the kinematograph camera from its early days would provide material for a very lengthy paper.[1] It is, however, worth listing the names of the early manufacturers in this country and abroad. Robert W. Paul was, of course, the first engineer in this country to produce cameras other than experimentally. He was followed by J. A. Prestwich, Alfred Darling, J. A. Williamson, Moy, Wrench, Arthur Newman, Beck, and later Vinten. In France the leading makers were Lumière, Debrie, Eclair, and Pathé ; in America, Mitchell, Bell and Howell, Akeley, and Wall. Germany, until the recent war, seemed little interested in originating camera designs, although her makers copied models of several other makers, notably Debrie.

I—REQUIREMENTS OF CAMERA DESIGN.

The perfect camera has yet to be built, but let us examine the main requirements. The first is the lens and the lens focusing. The poorest lens made, well mounted, will produce a sharper image than the best lens badly mounted. For the speed and accuracy required at the present day, the cameraman must rely on his lens scale, and it is a fact that a lens cannot be focused visually as accurately as a well-mounted lens can be calibrated.

In earlier days it was necessary to perform all dissolves, mixes and trick work in the camera on the floor of the studio, and it was always a good selling point to have as many aids to this work as possible built into the camera, such as automatic and hand fades, direct reverse, built-in mask holders, etc.

Nowadays the majority of dissolves, fades, and mixes are produced on the optical printer, a much more convenient method, as it can be worked on apart from the rush and tear of production. In fact, the optical printer, in the hands of experts, has become one of the most important aids to kinematography, and often comes to the rescue of a day's work which would otherwise have had to be scrapped.

Focus and Look-through.

Other requirements are means of focusing and framing up the picture, either on ground glass or through the film ; means of changing the lenses with the least possible delay ; a shutter, revolving or otherwise, which covers the film during movement ; magazines which will feed and take up the film with the

* Formerly Gainsborough Pictures, Ltd.

least possible friction ; a synchronous electric motor for sound, and a variable speed motor for trick work or exteriors.

Front attachment or sunshade must be as compact and as light as possible ; filters must be easily inserted. The wide use of filters and diffusion discs calls for some standardisation of matte boxes, so that these very necessary aids to photography can be fitted easily without the cameraman's best friend—tape.

A tachometer for checking correct speed is needed, also a footage counter for accurately measuring the length of exposures down to a single frame.

In the days when the negative stock was a light yellow colour in appearance, it was a simple matter to check composition and focus directly, through the film, and many camera manufacturers provided for this method in their design. With the arrival of grey-back stock, modern wide aperture lenses, and much faster emulsions, resulting in less light being required for exposure, this method is fast dying out. Designers have turned to various other methods of framing the picture. Outside view-finders with an automatic compensation for parallax have been a popular method for many years.

During the last few years, manufacturers have worked on the mirrored shutter system, the shutter placed at an angle, its front surface silvered, and the image

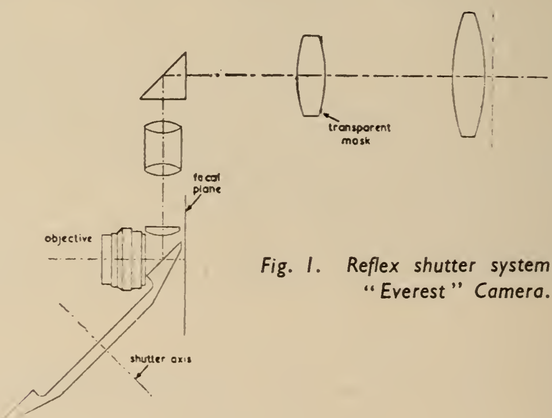


Fig. 1. Reflex shutter system of Vinten "Everest" Camera.

reflected to the eye-piece by means of prisms. This method is now being used in a number of cameras with great success.

Manipulating the Camera.

Lightness and compactness are also important requirements. The heavy cameras and blimps of to-day have caused a return to geared pan and tilt heads. The friction head, to my mind, is a more flexible method of panning and tilting, but owing to the weight of modern equipment it is very tiring for operators ; also lightness saves a lot of floor time in moving from set-ups, such as from dolly to tripod, crane, etc.

A standardisation of locating methods on tripods, dollies, etc., would be another time-saver. The tripod screw has stood the test of time but is fast dying out. Many manufacturers have introduced quick-release methods of various kinds. Technicolor have a parallel dovetail plate, Debrie a wedge dovetail plate, very different in size. But if a standard were to be fixed it would be a very useful advance.

II—THE INTERMITTENT MOTION.

There are many types of camera movements, and it is interesting to note that all cameras made in the prominent countries producing films can be easily identified, as the manufacturers, while improving on their original designs, have not altered in any great detail the pull-down mechanism or general arrangement of lens mounts, magazines, loading, etc.

The essential part of a motion picture camera is the pull-down mechanism, or intermittent motion.[2] The mechanism must be constructed to the highest limits of accuracy, and be able to perform the cycle of drawing the film past the aperture and stopping it millions of times, to an accuracy of a few ten-thousandths of an inch. It must be done without damaging the film surfaces by scratches, or damage to the perforations. Sufficient pressure must be put on to the back of the film to keep it flat in the gate for correct focus. The moving parts should be perfectly balanced to eliminate friction and vibration, and in the case of studio cameras silence is essential.

Camera movements can be classified roughly into three groups : cam movements ; crank movements, with and without register pins ; and the trip pawl movements.

In the days before the stock manufacturers took over the vital job of perforating film, the stock was sold unperforated ; the camera makers also made perforators, and it was considered necessary to perforate specially for the camera in use on the makers' own perforators. At the factory of Newman & Sinclair in 1910 and 1911 we had our own perforating room, and customers used to bring their stock in before setting out on a job. However, thanks to careful standardisation, that necessity has long since passed.

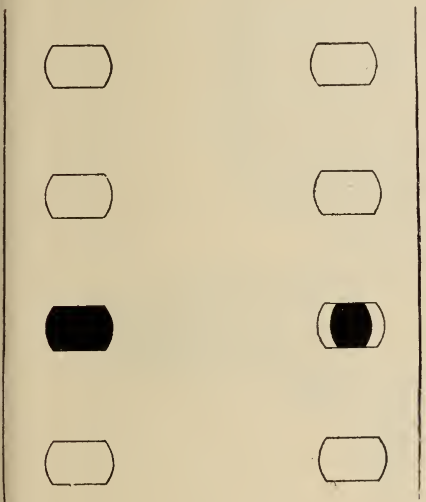


Fig. 2. One register pin locates the perforation in both directions, the other fits only in height.

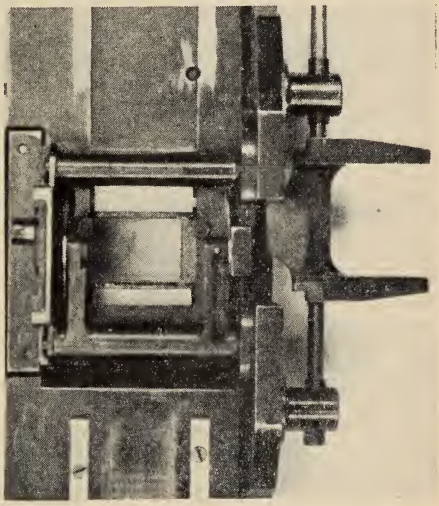


Fig. 3. Bell & Howell shuttle-gate motion, in which the film is registered by fixed pins, and is lifted off them by a reciprocating gate, actuated by a drunken cam-slot.

Register Pins.

With the steadiness required in these days, and with the film speed of 24 frames per second, the register pin is a vital part of the mechanism. Some mechanisms rely on side and front pressure to retain steadiness, but this is not sufficiently accurate, as steadiness depends on the exact width and straightness of the film.

The most reliable types have two register pins, one fitting the perforation exactly and the other fitting only the height ; this requires only back pressure in order to keep the film in its correct focal distance from the lens.

The Bell & Howell clapper gate is the most successful of all in this respect, but has the disadvantage of being noisy. In this system, the film is lifted off two fixed register pins, pulled down by two moving pins to its next position, and then clamped in its correct optical plane. The need for silent operation has led to the use of moving register pins, with back pressure only ; a disadvantage of these is that the pins are moving in and out while the film is being exposed, and if the perforations should be small—due, for instance, to worn punches in the perforator—the effect known as " breathing " is produced. Thanks to the untiring efforts of stock manufacturers, this is rarely experienced, and then only when the film stock is old and shrunk.

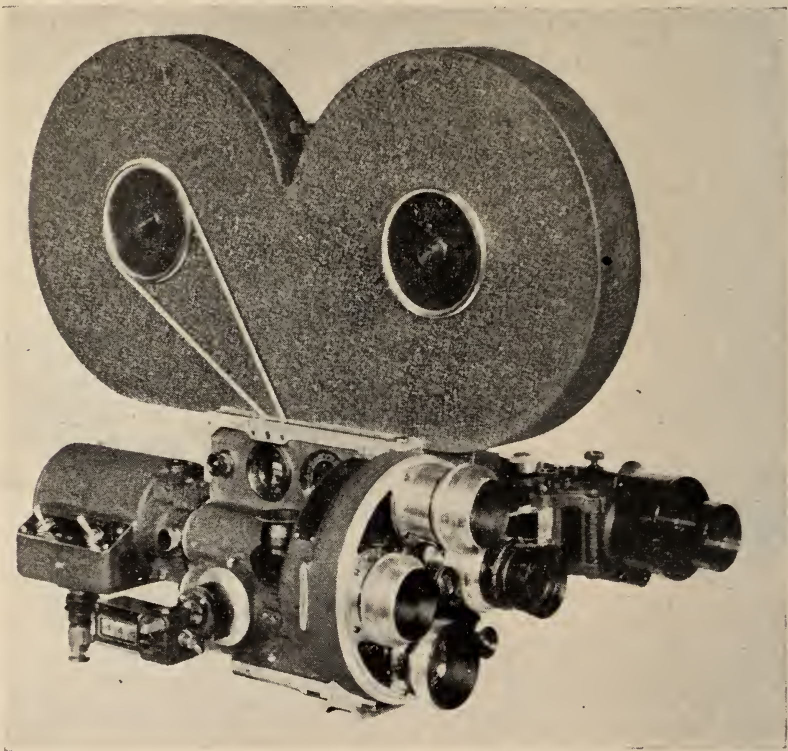


Fig. 4. Bell & Howell studio camera—a development of the camera which first introduced all-metal construction, lens turret, and twin top-mounted magazine.

Side Registration.

Simple crank movements are used in the majority of portable cameras, the gates employing side and back pressure only. These, when care and attention is given to them, give excellent results for news-reel work and all shots not requiring a high degree of accuracy, as is required for double exposure, critical animation work or back-projection plates.

Some cameras successfully used a crank movement with a single claw and a fixed register pin. Many cam movements give their origin to that famous French pioneer, Lumière, using a triangular cam to move the claws up and down, and a drunken groove or plate to enter or withdraw the claws into or from the perforations.[3]

III—MAGAZINES.

The magazines are another point which will bear investigation. A 1,000 ft. roll of film is an appreciable weight on an overhung shaft, and if not perfectly

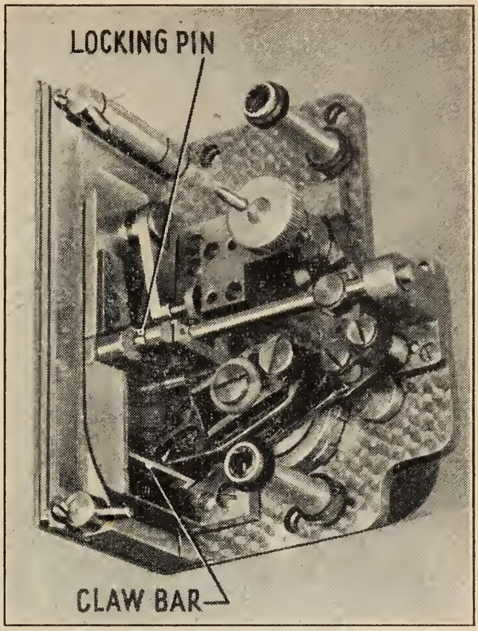


Fig. 5. Intermittent motion of the Newall camera—a light-running crank—driven mechanism.

centred on the bobbin can cause unnecessary load on the motor. An excellent example in this respect is the 200 ft. Newman magazine, which, having an internal spool, cannot bind up on the sides of the magazine. All velvet, a good dust collector and generator of static, should be dispensed with.

Many manufacturers prefer the side-by-side internal magazines situated at the back of the camera. Outside magazines, however, save a considerable time on the floor, as the film can be removed easily without breaking. It was once a common thing to remove the magazines after a scene had been shot, and mix in to another shot, days later. Magazines of 400 ft. capacity were the largest obtainable up to about 1916, so that the advantage of not having to break the film meant a considerable saving in short ends.

Take-up Drive.

One further feature that could well be adopted by the industry is the use of a vee-belt to drive the magazine. Most cameras use a belt of some sort to drive the take-up side of the magazine ; how many times has a camera jammed, merely because the leather or spring belt has become too loose or the clip has broken through the belt. In the Technicolor magazine each film is wound up on its own friction hub by a belt that cannot slip—a very sound design. A jam on a Technicolor camera from this reason is almost unknown.

Furthermore, the film is pulled out of the feed side of the magazine under friction, and this prevents scratch due to the film floating about when the

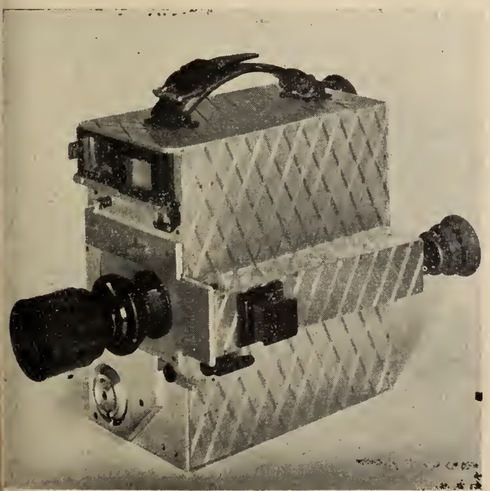


Fig. 6. The Newman Auto-camera, the first camera to use a fixed register pin. Thanks to its lifting gate and simple crank-actuated claw motion (with single claw), the double-spring motor is capable of running 170 to 200 ft. of film at a wind, at a speed sufficiently constant for synchronism to be maintained, without interlock, with a sound film.

magazine is being carried around or when the camera set-up is being changed. Any camera manufacturer may well give this last point thought, for not only does it tend to prevent scratch, it prevents the " snatch " that takes place when the roll of film becomes slightly unwound and the camera is started up at full speed.

IV—LENS SYSTEMS.

The single lens system is, in my opinion, the best method of lens mounting. Turrets mostly carry four lenses, the usual range embracing 24 mm., 28 mm., 35 mm., 40 mm., 50 mm., and 75 mm. The need to remove a lens from the turret in order to use a lens of different focal length results at times in unnecessary delays. Further, when lenses are stored separately it is easier to check the surfaces for cleanliness.

The lens scale is indispensable to the news or combat cameraman, who always has to be ready in a split second to cover an incident. In the studio to-day, of course, the focus assistant relies on his scale when making focus changes while the camera is tracking backwards and forwards, sometimes

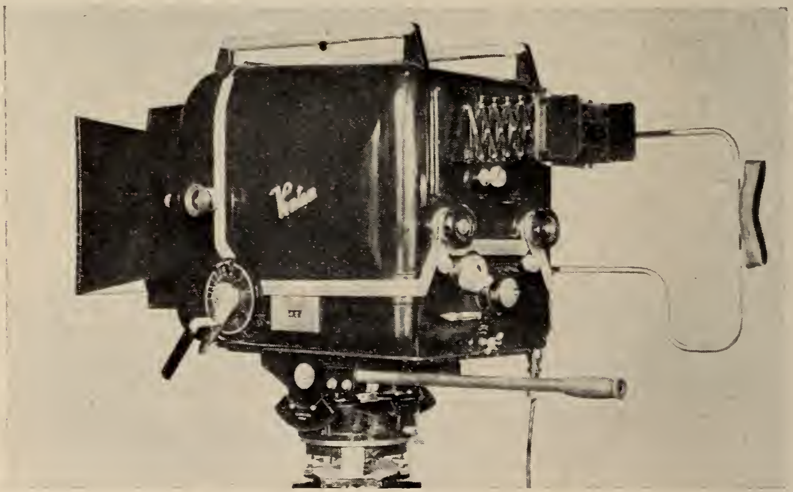


Fig. 7. Vinten " Everest " Camera, with side-by-side magazines, reflex shutter, and, in the Type 2, a coupled range-finder.

anything from 50 ft. to 6 ins. Obviously, there must be no back-lash, and the lens must be accurately centred.

Focusing Methods.

Focusing has been effected in the past by the use of hand controls, through gearing situated in convenient positions outside the blimp or sound-proof casing, but many of these methods suffer from back-lash, and it depends on the skill and experience of the assistant in getting used to his own particular camera. These technicians, through practice, get an uncanny sense of distance, and are able to make allowances for artistes who do not always arrive at the prescribed position.

Methods of hand control fixed to the blimp are often a handicap to the operator, as in quick pan he can feel the assistant endeavouring to perform his duties. The Selsyn control which has been introduced eases this problem and separates the assistant from the camera. Another advance of recent years is the built-in synchronising method, between the picture and the sound cameras ; this eliminates the annoyance of holding up clapper boards in front of the artistes, and makes floor work a much less noisy procedure than before.

The outside view-finder with automatic parallax is a good method of following, but I personally favour the positioning of the view-finder in the centre of the back of the camera, as in the Vinten "Everest."

V—REQUIREMENTS OF CAMERA USERS.

Having spent half my life in the manufacturing of cameras, and the other in using and maintaining them, I feel I can claim a knowledge of the requirements of the various users of apparatus.

First we will take the newsreel cameraman. He combines the arts of the photographer and the Fleet Street reporter, and is sent out to get the best possible record of any particular happening. He is first of all a diplomat, who often, by his own personality, arranges the coverage of the story. He must then be ready to shoot at a moment's notice. Often a hand camera is the only method, but up to date there is not one that is silent in operation, and noisy cameras at interviews, or at sports meetings, such as golf, are a distraction to everybody.

A staggered turret is a very important asset, and a means of swinging lenses quickly is essential. A built-in coupled range-finder should be another feature of this equipment. These requirements are gradually being incorporated, and a news cameraman has various cameras suitable for the story he has to cover; with the added asset of silence his job would be considerably lightened.

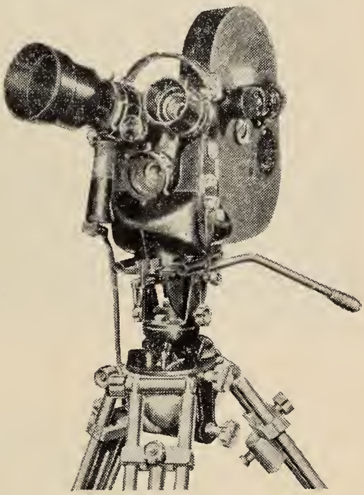


Fig. 8. The Eclair "Caméflex," a camera particularly suited to work under difficult conditions. 100 ft. or 400 ft. magazines can be fitted, the staggered lens turret permits lenses of long and short focal lengths to be used, Drive is by hand, or by a battery-operated motor.

The Studio Camera.

Studio floor cameras present different problems, which can open up a very interesting debate. They do not need the shutter dissolve and other devices deemed necessary in the past.

The first essential is silence, achieved by the finest of workmanship, and in the design the avoidance of large unsupported surfaces, the use of self-oiling bearings and of non-metallic gears. It is undoubtedly an advantage if silence can be achieved without the use of a cumbersome blimp.

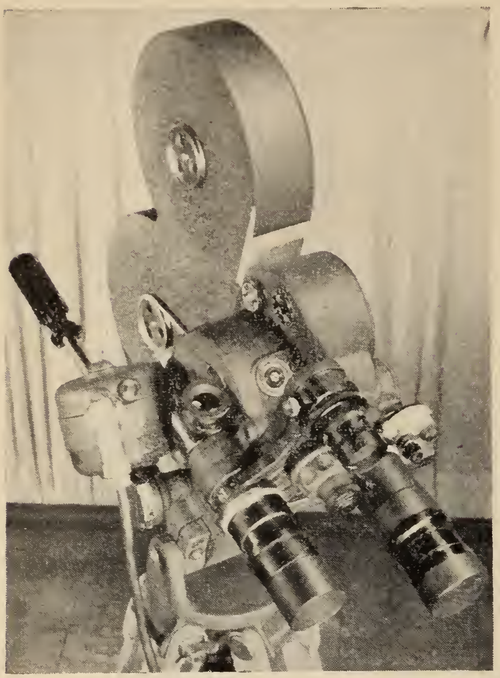
Rapidity of setting up is a vital factor. It must be possible for the scene to be viewed as a well-lit upright picture ; it is an advantage too if the view-finder permits of the part of the scene immediately beyond the lens limits to be seen. Another accessory making for rapidity in working is a coupled range-finder.

Since cameras have to be used in different studios, and on location, provision for full interchangeability of driving motors is essential.

The Cartoon Camera.

Animation, cartoon or trick photography requires different apparatus altogether. Nearly always the equipment for such work is a camera considered past its best days for other purposes, and yet this work is the most exacting of all. The importance of a large viewing system for exact checking cannot be over-emphasised ; other requirements are an accurate counting system down

Fig. 9. The Bell & Howell "Eyemo" Camera, widely used for news-reel work thanks to its portability and ease of handling.



Courtesy Ideal Kinema

Fig. 10. The "Arriflex." Fitted with reflex shutter. It is driven by a battery-fed motor contained in the handle.

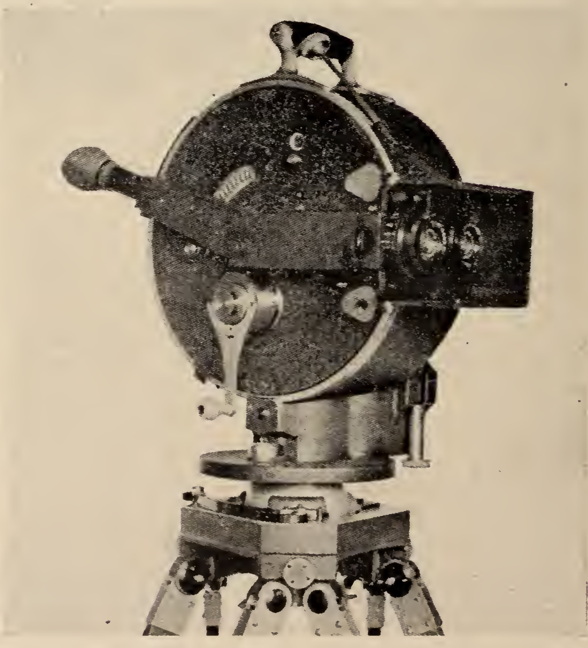


Fig. 11. The Akeley Camera, whose unusual design includes focal-plane shutter and twin lens panel.

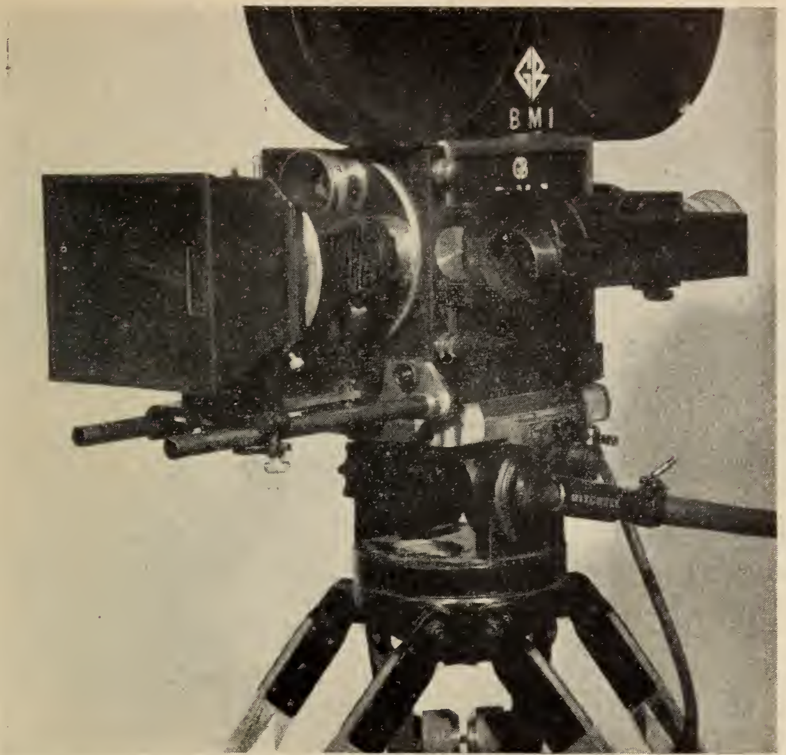


Fig. 12. *The Mitchell Camera, in which for focusing, the body of the mechanism is racked over, to bring a ground glass in place of the film.*

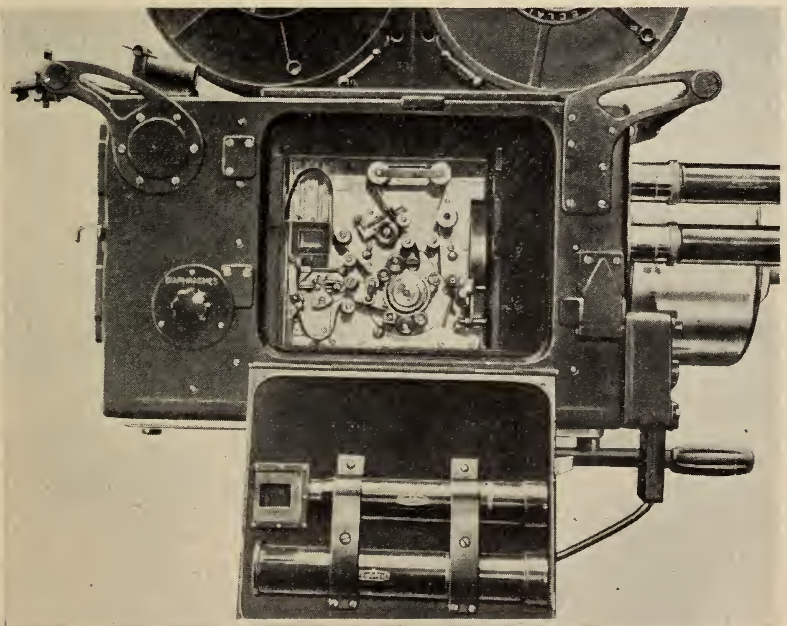


Fig. 13. *The Eclair Studio Camera, showing inside the open door the focusing magnifiers.*

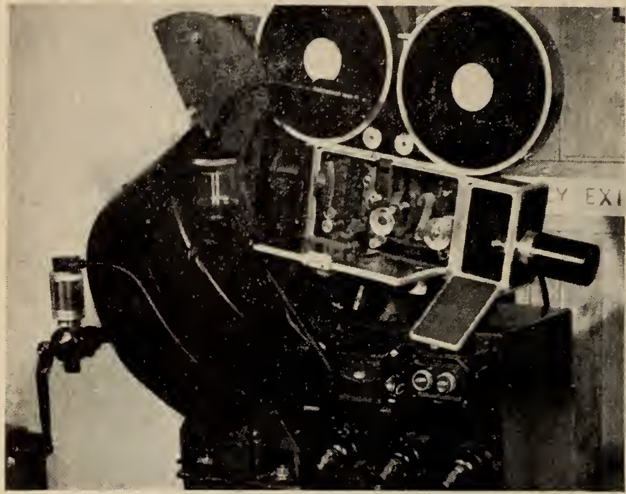


Fig. 14. Vinten camera with Visatone sound head, as fitted to the Mechau Arcadia non-intermittent optical system, used at Alexandra Palace for recording television images from the screen of the cathode-ray tube

to single frames—preferably film fed—a direct reverse, visual means of checking that the forward and reverse take-ups are operating, and a shutter fade mechanism whose operation can be varied as required by the various effects. A simple but rock-steady pull-down mechanism is essential, easy to thread and clean. An easy means of attaching a three-colour filter holder is important for successive-frame colour photography.

The Colour Camera.

Millions of pounds have been spent in research on the colour film, and the number of systems is too great to mention. The Technicolor Corporation of America decided that the three-strip method was in the long run the most commercial for release copies. Their camera is a remarkable piece of precision work, and owing to the meticulous manner in which it is serviced, gives very little trouble in operation.[4]

An interesting three-strip camera of British design is the British Tricolour camera, which, like the Technicolor, employs the " bi-pack and one " principle. An advantage of its design is ease of threading and maintenance.[5]

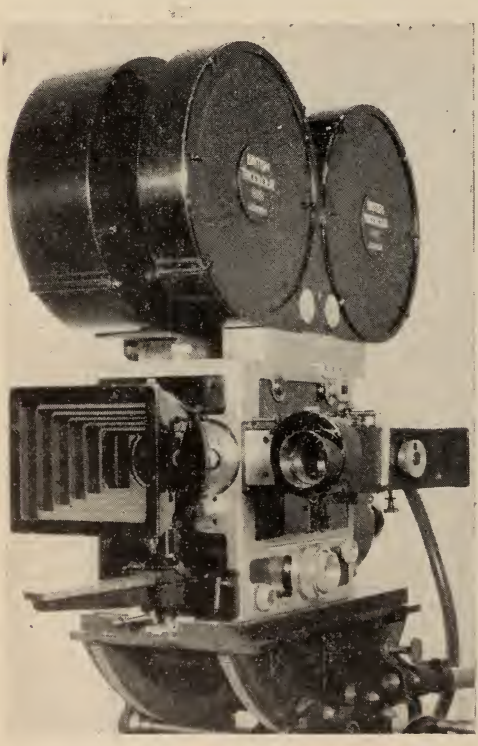


Fig. 15. In the British " Tricolour " camera the bi-pack gate may be swung away for ease of loading and cleaning. A special series of Wray f/2 lenses is fitted.

Fig. 16. A post-war product of the world-famed firm of precision engineers, the Newall Camera, after having proved itself in the studio, has now been fitted, as shown, with a single-film recording head.

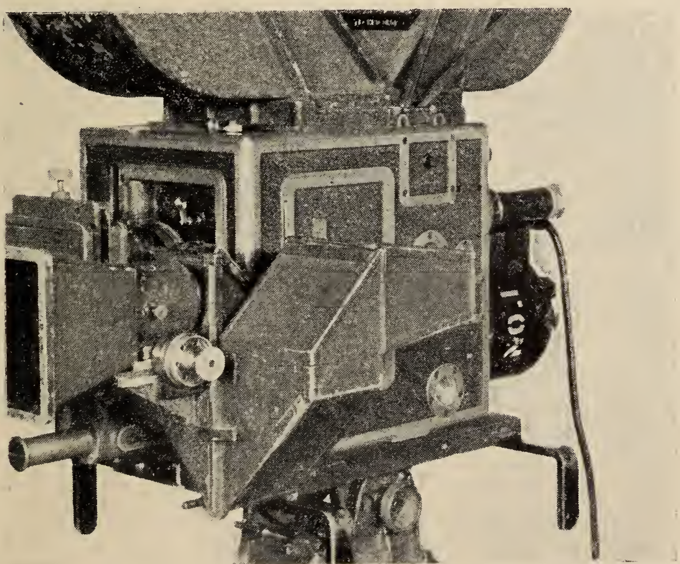


Fig. 17. The Technicolor Three-strip Camera employs a gold-coated prism block to produce a green image by transmission, and by reflection, blue and red images upon a bi-pack.

VI—CONCLUSION.

There are innumerable other cameras I have not mentioned because of time, which are all equally interesting in design. Many years have gone into research on television aids to film production, such as view finders. Maybe the future will see the television camera used on the stages, the pictures relayed back to film cameras in the laboratories. This method is in use by the B.B.C. at the moment for a number of subjects, but whether it will ever become universal is in the hands of the research engineers, who in this country are making every effort to solve the problem.

But, whatever the technique, picture-making will be the same. The quality of reproduction on the large kinema screen is the thing that counts.

Sections of film made 25 years ago were projected and showed a surprisingly high standard of photography and steadiness.

APPENDIX.

Some of the leading manufacturers of to-day are :

GREAT BRITAIN

W. VINTEN : " Everest " Studio Camera with mirrored shutter.[6] Newsreel combined Sound and Picture Camera. Model " H " Studio and Exterior Camera. " Normandy " Camera, Hand or Motor Driven.[7]

G.B.-KALEE : Newall Studio Camera.[8] Newall combined Sound and Picture Camera.[9]

NEWMAN-SINCLAIR : 400 ft. Studio Camera. 200 ft. Automatic Hand Camera.[10]

FRANCE

DEBRIE : " Super-Parvo " Studio Camera. 400 ft. Model.

ECLAIR : Cameréclair Studio Camera. Caméflex electric, hand, or spring-driven Camera.[11]

AMERICA

MITCHELL : Standard Camera. N.C. Studio Camera. B.N.C. Blimped Studio Camera.

BELL & HOWELL : Standard Camera with shuttle gate or trip-pawl mechanism. Automatic Camera, electric, hand or spring driven.

DE VRY : Hand Automatic, spring driven.

AKELEY : 200-ft. Model with focal plane shutter and matched lenses for focusing.

WALL : Studio Camera.[12] Combined Sound and Picture Camera.

GERMANY

ARRI : Arriflex Hand or Motor-driven Camera with mirrored shutter.[13]

ASKANIA : Motor-driven Hand Camera.[13]

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DISCUSSION

MR. K. GORDON : In making a Newman camera run the full 200 ft. of film, the most important things are the magazine traps and gate.

THE AUTHOR : The Newman should not give much trouble from pick-up. But all the other gates should be slightly lubricated. With regard to magazine traps, various manufacturers have gone different ways about it. The Newman 200 ft. model, also the Vinten, has a metal trap, which is quite light-tight.

MR. GORDON : Present film stock contains a proportion of free acid. The etching caused by the acid is extraordinary. What about hard chromium for the gate surface ?

THE AUTHOR : This is done in many cameras.

MR. H. WAXMAN : Has Mr. Hill any information on the Australian camera that is claimed to be all-electronic ?

THE AUTHOR : The camera was invented by John Knox. I regarded it as an example of misplaced genius. For one thing, the mirror shutter was in front of the lens.

MR. R. H. CRICKS : In the recent Gaumont news-reel of the Grand National we saw the horses going at normal speed up to a jump, which was shot in slow motion. How was that done ?

THE AUTHOR : With a motor having a variable resistance, so that you can change from normal to high speed quickly, at the same time adjusting the lens stop.

MR. GORDON : A Debrie camera adapted by Arthur Kingston had automatically adjusted exposure as it speeded up. A governor opened the shutter instantaneously.

Mr. B. HONRI : On a number of Technicolor films the originals have been shot on 16mm. Kodachrome and blown up to 35mm. Is there any prospect of 16mm. negative being used for black-and-white, giving results equal to 35mm ?

THE AUTHOR : That is mainly a problem for the laboratory. 16mm. will play a very big part in the future, once they get down to really fine-grain stocks.

Mr. B. KNOWLES : What about wide-angle lenses ? The shortest focus at present is 15mm.

THE AUTHOR : That also is a matter for the lens manufacturer.

MR. C. VINTEN : Neither the Maurer nor the Mitchell 16mm. cameras has register pins.

THE AUTHOR : The Mitchell has ; it is a miniature of the standard Mitchell camera.

MR. P. VINTEN : As we are only pulling the 16mm. film through by one side, and we have found in 35mm. practice the finest way to register is not off one perforation and a side but from two perforations, how are we going to get accurate steadiness for superimposition ?

MR. N. LEEVERS : Details have been recently published on the use of sapphire as a gate material. Do you know of any work being done on that in this country ?

THE AUTHOR : Newman tried it twenty years ago. We got reasonable results. But in television recording cameras they use sapphire studs and the film is pulled down with a Geneva cross at about six times the speed.

MR. W. S. BLAND : Reverting to the 16mm. question, I believe that in the States, in order to get over the grain question, they do most of their original photography either on reversal stock or on Kodachrome. The present standard of 16mm. sound prints almost forces you to do this, otherwise the picture comes out back to front on the print, since the sound track is on the wrong side to work from a direct negative.

MR. D. CANTLAY : In making a print from 16mm., you can easily change on the optical printer.

MR. H. WAXMAN : What advantages, other than silence, are we going to get from the complicated business of television recording in the studio ?

MR. P. VINTEN : It has been suggested that you should have the recording camera immediately above the negative tank in the laboratory, so that by the time the next set-up is ready, you could play back the last scene.

MR. D. STEWART : A practical advantage is that you could work at much lower brightnesses.

MR. BLAND : It was intended to fit up a monitoring theatre where the director could see exactly what he had shot. In that way they hoped to cut down retakes. It might be of advantage in news-reel work, where you could take advantage of the greater sensitivity of the television camera.

MR. R. H. CRICKS : Another proposal is to use an electronic travelling-matte system.

EARLY CAMERAS PRESENTED TO B.K.S.

At the meeting of October 4 last, the President announced that, by the courtesy of Mr. Castleton Knight, of the G.B. News, and of Mr. J. S. Abbott, Hon. M.B.K.S., two cameras of early design had been presented to the Society.

These cameras were a Moy camera embodying patents of Mr. P. H. Bastie ; and a Proszinski Aeroscope compressed-air camera, made by the late Arthur S. Newman.

Mr. Watkins expressed the appreciation of the Society for this valuable presentation.

MEASUREMENT OF BRIGHTNESS AND ILLUMINATION OF THE KINEMA SCREEN

F. S. Hawkins, Ph.D., M.B.K.S., A.R.I.C.* and H. W. W. Losty, B.Sc.*

SATISFACTORY projection of kinematograph films is achieved only when the full range of tones in the print appears on the screen, *i.e.*, when the highlights and shadows are both fully reproduced. To obtain projection of this quality the projector, when running without film, should illuminate the screen to give an adequate brightness, for this sets an upper limit to the brightness of the highlight and hence to the range of tones that can be reproduced. The lower limit to the range, reached in the projection of the darkest shadow, is fixed by the normally small amount of stray light which reaches the screen after reflection from the walls, ceilings and other similar fittings in the auditorium.

1—The Screen.

The elementary requirement of a bright white screen is universally recognised by the choice for a new screen of a white surface which reflects between 70 per cent. and 80 per cent. of the light falling on it. What is perhaps less well known is the effect of the deterioration caused by agents such as tobacco smoke and dust, which may cause a yellowing of the surface greater in its effect on colour rendering than the change from a high intensity to a low intensity arc, and also a reduction in the amount of light reflected from 80 per cent. to 40 per cent.[1]

Too low a brightness will cause discomfort to the patron ; he will have difficulty in seeing the film when the contrast is so reduced that the brightness of the high lights approaches that of the darker parts of the picture. On the other hand, the brightness of the screen can be too great ; when this occurs grain and flicker become apparent. The range of satisfactory brightness and the troubles which arise outside this range are clearly shown in British Standard 1404, on screen brightness, and its appendix.[2]

2—Measurement of Screen Brightness.

These considerations show that the best projection results are obtained only if the screen has a brightness between 8 and 16 foot-lamberts. It may be measured by a number of methods, which can, for convenience, be divided into two classes, namely, visual methods, and photo-electric methods.

3—Visual methods of Brightness Measurement.

Since the eye responds to the brightness of the objects it sees, all visual photometers are primarily concerned with the measurement of brightness. Their function is to present to the eye a view of the surface whose brightness is to be measured, adjacent to that of a surface whose brightness can be varied in a known manner, in such a way that the brightnesses of these two surfaces can be made equal.

The brightness of the surface under examination, in this case the screen, is then the same as that of the comparison surface, the value of which can be read on the scale of the instrument. The Macbeth photometer is such an instrument. A suitable form is one in which the two surfaces are viewed by means of a Lummer-Brodhun contrast head to produce the field shown in Fig. 1, this field subtending an angle to the eye of 2° to 6° according to the design of the instrument.

The reference surface is an opal glass disc whose brightness can be varied by moving a small tungsten filament lamp towards or away from it. If the

* Research Laboratories of The General Electric Company, Limited, Wembley, England.

light output of the lamp is kept constant by running it at constant current and voltage, then the distance between lamp and disc can be used as a measure of the brightness of the disc and hence of the brightness of the screen. Such an instrument, when correctly calibrated, and when used by an experienced observer, will give results of the highest accuracy that can be expected from a portable photometer, *i.e.*, within 10 per cent. of the true value.[3]

A similar brightness meter of a more portable and less expensive nature is the S.E.I. exposure meter.[4] Its field of view permits the observer to see the object he is viewing, which is for many purposes a useful feature, and to compare its brightness with that of the small spot in the centre. The comparison lamp is maintained at constant brightness by means of a built-in photo-cell and microammeter, the current through the lamp being varied by a resistance until a standard deflection on the meter is obtained. The brightness of the reference surface is varied by a variable density filter placed between the lamp and the opal screen and the scale of the instrument is calibrated directly in log foot-lamberts.

The angle of view obscured by the reference surface is very small, 0.5° or less, and so the instrument can be used to measure the brightness along a particular line of view ; consequently the brightness of a very small part of a kinema screen can be measured from anywhere in the auditorium.

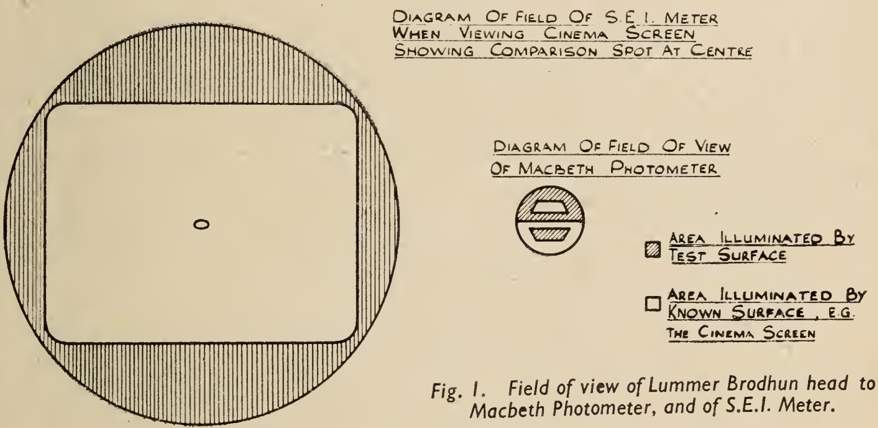

Fig. 1. Field of view of Lummer Brodhun head to Macbeth Photometer, and of S.E.I. Meter.

4—Effect of Colour Differences on Accuracy of Measurements.

The use of visual photometers for measurements such as these has often been criticised on the grounds that any appreciable difference in colour between the light from the surface under examination and from the comparison lamp in the photometer will lead to difficulty in balancing the photometer fields to give equality of brightness.

Tests have shown, however, that even an entirely unskilled observer will get results within 20 per cent. of the true value, and higher accuracy can be obtained with a little practice.

At first sight it might be thought that such errors are large, but they should be considered in the light of the British Standard for portable photometers[3] which anticipates a 10 per cent. error when there is no colour difference between the light sources, and the British Standard for screen brightness, which stipulates limits of 8-16 foot lamberts, a difference as great as 100 per cent.

In the light of these facts it can be seen that meters such as the S.E.I. exposure meter can be used for all ordinary measurements of screen brightness, but when higher accuracy is required, instruments which are not so compact or so readily portable must be used.

5—Polar Curve of Screen.

Both the visual brightness meters described pick up light for measurement purposes over a very small angle. As a result they pick up only a small amount of light, but as the eye is a very sensitive instrument, this is no disadvantage. Photo-electric meters, which may not be so sensitive, do not always pick up their light from such a small angle, and if instead the angle is large, then they may not, with some types of screen, read true brightness. In some cases this error is considerable. Its extent depends upon the polar curve of the screen, and increases as the polar curve departs from that of a uniform diffuser.

Reflection of light by a surface may be diffuse, as in the case of a matt white screen, or specular, as for a mirror, or intermediate between these two limiting cases. Examples of the latter are given by beaded and metallised screens. When a uniformly diffusing surface is illuminated by a kinema projector it will appear equally bright from all angles of view, whereas one that is entirely a specular reflector, such as a mirror, has, under these circumstances, a very high brightness in a particular direction, the angle at which specular reflection occurs, and nearly zero brightness in other directions. Beaded and metallised screens

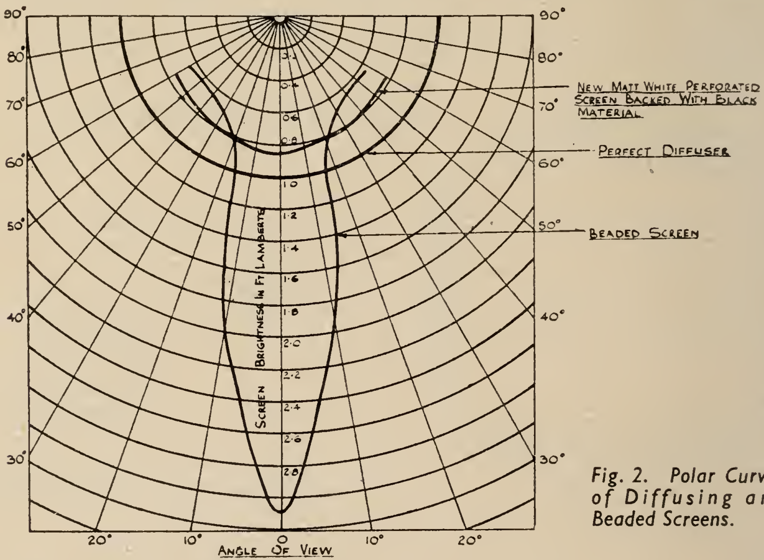

Fig. 2. Polar Curves of Diffusing and Beaded Screens.

are intermediate ; they have a maximum brightness in a certain direction, which is intended to be the direction in which the seats of the kinema are located, and a much reduced, but still appreciable brightness, in other directions.

It is clear from these considerations that the brightness of a screen, for any given conditions of illumination, can be plotted against the angle from which the screen is viewed, so giving a polar curve of the brightness of the screen. The shape of this curve can be forecast in a general way by considering the screen to be made up of two co-existing surfaces, one of which is a uniform diffuser, the other a specular reflector.

Thus in the case of the matt white perforated screen, the specular element is almost absent and the screen is very nearly, but not quite, a uniform diffuser. If it is illuminated by a projector set normal to the centre of the screen, *i.e.*, with an angle of rake of 0°, the weak specular element will send light directly back to the projector and the much stronger diffusing element will spread the light uniformly in all directions. The combination of these two will give the curve in Fig. 2, where the brightness of the centre of a screen of this type is

·85 units at the normal, falling slowly to ·77 units at an angle of 60° to the perpendicular.

In the case of a beaded or metallised screen (also Fig. 2) the specular element is comparatively strong and if the screen is again illuminated with an angle of rake of 0°, much of the light is reflected straight back to the projector. Consequently the brightness in this direction is, for the same illumination, much higher, over 3.0 units, with correspondingly lower brightnesses away from the perpendicular, where the effect of the comparatively weak diffusing element predominates.

The curves discussed above are for the case in which the centre of the screen is perpendicular to the incident beam. This is rarely met in practice ; there is nearly always an angle of rake, and the effect on the polar distribution of brightness of light arriving at an angle to the normal depends upon the nature of the specular element in the screen. In the case of the normal type of beaded screen, the maximum screen brightness will still be in the direction of the

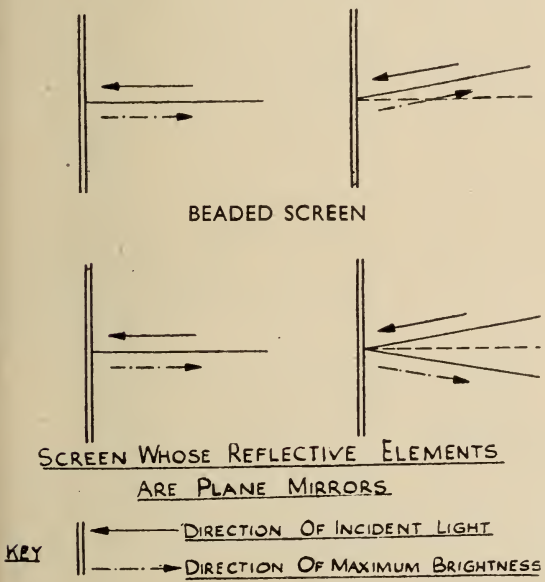

Fig. 3. Effect of angle of rake on Polar Curves with different types of Reflective Element.

incident light, and the screen will still appear to have its maximum brightness when viewed from the projection room porthole. If, however, the reflective elements are equivalent to plane mirrors, then an entirely different result is obtained. In this case, the direction of maximum screen brightness is at an angle to the perpendicular equal and opposite to the angle of rake, in accordance with the ordinary laws of specular reflection from a plane surface. These two cases are illustrated diagrammatically in Fig. 3.

The brightness of any point on a kinema screen therefore depends upon :—

(1) The incident illumination.
(2) The angle at which the light is incident on the screen.
(3) The particular combination of diffusing and specular reflecting properties possessed by the screen.
(4) The angle at which the point in question is viewed.

The most convenient way of expressing the relations between these four quantities is by a family of curves in which the brightness of the screen for unit incident illumination is plotted against the angle from the normal at which it is measured. Each different angle of rake gives a separate curve, and the family of curves so obtained tells the whole story. As, however, change in the angle of rake has little effect on the shape of the curve, but a considerable, yet calculable, effect on its direction, for most purposes the single curve, such as that shown in Fig. 2 for a beaded screen, will give all the required information.

In view of the widespread habit of smoking in kinemas, it is perhaps worth noting that the brightness of a screen is independent of the distance from which it is viewed only when the atmospheric transmission is 100 per cent., but loss of brightness from this cause does not appear to be detectable at the beginning of the day's showing of films.

6—Photo-electric Methods of Brightness Measurement.

A polar curve such as Fig 2 (beaded screen) can be used to show how errors may arise if a brightness meter which can receive light from over a large solid angle is used for measurements on a screen which is not a perfect diffuser. Suppose in such a meter, this angle, which is known as the acceptance angle, is 90°, and the meter is used on a screen having the above polar curve. To avoid the additional complication arising from variation of incident illumination across the screen, assume that the meter is placed close to the screen so that the area of screen it can " see," *i.e.* receive light from (Fig. 4) is small and so

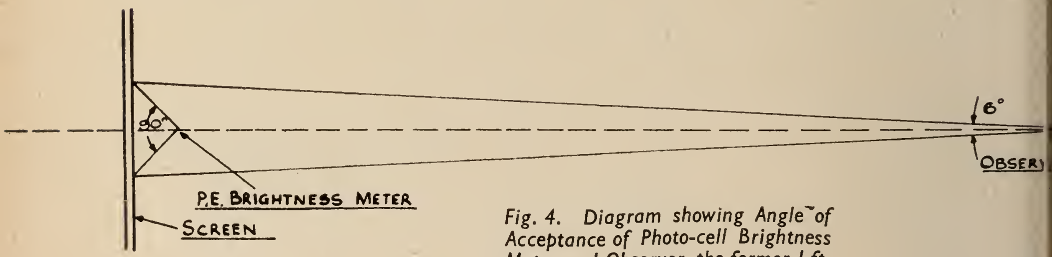

Fig. 4. Diagram showing Angle of Acceptance of Photo-cell Brightness Meter and Observer, the former I ft. from the Screen, the latter 20 ft.

is uniformly illuminated. Assume too that the illumination is incident perpendicular to the screen. The photometer will then receive light from an area of the screen which will not be of constant brightness, as can be appreciated by placing the eye in place of the photometer and looking at the screen. The brightness at the centre of this area will be zero, for the centre will be in the shadow of either the photometer or the observers' head, according to the circumstances. Immediately outside the shadow the brightness will be a maximum, and it will fall off as the angle between line of vision and the screen changes precisely as shown by the polar curve in Fig. 2 for the beaded screen under discussion. For such a meter with an acceptance angle of 90° the brightness in the centre will (Fig. 2) be about 2.8 ft.-lamberts, depending upon the exact size of the shadow, falling to 0.65 ft.-lamberts at the edges, where the angle is 45° and the meter will read some intermediate value of brightness. It will not read the mean, but will be biased, in this case, towards the lower value, because more than half of the area of the patch of screen which illuminates the photometer has a brightness lower than the mean.

An observer sitting in a seat in the kinema close to the centre line of the beam and viewing the same small patch of screen will not see the same falling off in brightness. He will be much farther away from the screen than the photometer ; the latter may be one foot from the screen, whereas the observer will be 20 ft. or more, and the largest angle he will subtend will be 6° or less. To him, the brightness of the screen will be 2.8 ft.-lamberts or more (Fig. 2), whereas the photometer would record less than half of this value. No improvement would result if the photometer were moved back toward the observer, the errors already described would still be present, for they depend only on the acceptance angle of the photometer. Indeed in the case of a normal kinema screen, an additional error would be introduced by its lack of uniform illumination which, by causing a decrease in the brightness of the outer zones, still further depresses the photometer readings.

The above considerations assume that both the projector and the photometer are placed perpendicular to the centre of the screen. If these conditions are not fulfilled—and in practice they rarely are—then further errors, which are sometimes large, can be introduced.

Fig. 5. Photo-cell on Pole.

Fig. 6. Viewing Graticule.

All of these considerations point to the same conclusion, which is that measurements of the brightness of preferentially reflecting screens can be made with accuracy only if the angle of acceptance of the photometer is small. Most visual photometers are made with a small angle, but portable photo-electric meters frequently lack sensitivity and compensate for it by an increase in the acceptance angle. However, it has been found that sufficient accuracy for ordinary measurements is obtained if the angle of acceptance does not exceed 10°.

The simplest and most portable type of photo-electric photometer is one made essentially of a rectifier cell and microammeter. Such an instrument can be made to receive light from only a portion of a kinema screen if it is fitted with suitable diaphragms, or a lens which images the required part of the screen on the surface of the photo-cell. It will then function with sufficient accuracy as a brightness meter, if the diaphragms or lens system are arranged to give the necessary small angle of acceptance of 10° or less. However, the amount of light reaching the cell from the screen is then small and can be detected only with the aid of a sensitive galvanometer.

7—Screen Illumination Measurements in Kinemas.

Experience of the measurement of screen illumination in kinemas has shown that, given a photo-cell suitably mounted on a telescopic duralumin pole, as shown in Fig. 5, there is no difficulty in taking readings of the illumination falling on the screen. It is difficult, however, for the person holding the pole to know just whereabouts in the beam he is locating the photo-cell, and this difficulty is most acute when the screen is large. It can be overcome if the holder of the pole is assisted by a second person in the auditorium who calls our directions for moving the pole, and if this second person uses a viewing graticule then the photo-cell can be located with quite a high degree of accuracy, and it can be placed in any particular position with an error normally not greater than a few inches.

The viewing graticule, shown in Fig. 6, consists of an eyepiece and a graticule, which are mounted in a frame so arranged that the distance between them can be varied. The graticule consists of a piece of " Perspex " on which has been ruled in black ink a rectangle having the proportions of a kinema screen and a series of numbered marks which indicate the positions on the screen at which measurements of screen illumination are required. The device is attached to the back of a seat near the centre of the stalls and is aimed squarely at the screen. The distance between the eyepiece and the graticule is adjusted so that when the eye is placed at the eyepiece it sees the screen exactly framed by the rectangular outline on the graticule. The photo-cell is then moved by the operator holding the pole under the direction of the person viewing the screen until the cell appears coincident with the appropriate mark on the graticule. A reading of the screen illumination is taken, the cell is then moved until it appears coincident with the next mark and the process is repeated until a sufficient number of readings have been taken. A full set of readings with this particular graticule consists of twenty-three readings taken at points on the screen corresponding to those marked on it. These points are located at the centre of the screen and on three circles concentric with this point at the intersection of these circles with the vertical, horizontal and diagonal lines through the screen's centre.

8—Laboratory Measurement of Screen Illumination.

The methods described for the measurement of screen illumination in kinemas form a basis for a laboratory method, using apparatus in which readings are taken at the same twenty-three positions by photo-cells which are moved to each one in turn. The equipment used is described below.

It was designed for the measurement of the screen illuminations given by different carbons in various arc lamps, rather than for the comparison of projectors. The arc lamps, therefore, are mounted upon welded angle-iron stands and fitted with a removable mock-up of a projector consisting of a gate, shutter and lens, identical in principle with that previously described[5], but with improvements in detail, notably the provision of a lens holder to take lenses of any existing diameter, and the use of a synchronous motor to maintain a constant shutter speed giving 48 flashes per second when run from a 50 c/s supply. The central monitor cell is still used, but instead of four cells mounted on a horizontal bar, a single mechanically travelled photo-cell is used (Fig. 7). The illumination from the projector falls upon a black screen, so that the bulk of the light is absorbed by the screen and is not reflected back to the photo-cell from the walls and similar surfaces, and the surface of the screen is marked like the graticule with the twenty-three cell positions. The cell can be moved anywhere inside a rectangle 7 ft. x $5\frac{1}{4}$ ft., and so can measure the illumination on a screen this size. Its position is remotely controlled by the arc lamp operator who is beside the arc lamp. Proper adjustment of the projector for even illumination of the screen is facilitated by the use of two additional cells fixed at the right-hand top and bottom corners of the illuminated area. These are used in conjunction with the central monitor cell and the travelling cell, which is placed at either the top or bottom corner of the left-hand side ; the projector is adjusted until the central cell reading is a maximum and the corner readings are all equal. A full survey of the distribution of illumination over the surface of the screen is then obtained by using the travelling photo-cell to measure illumination at twenty-two points ; the monitor cell gives the twenty-third, central reading and also gives warning of any change in the general level of illumination.[5] From these readings the average

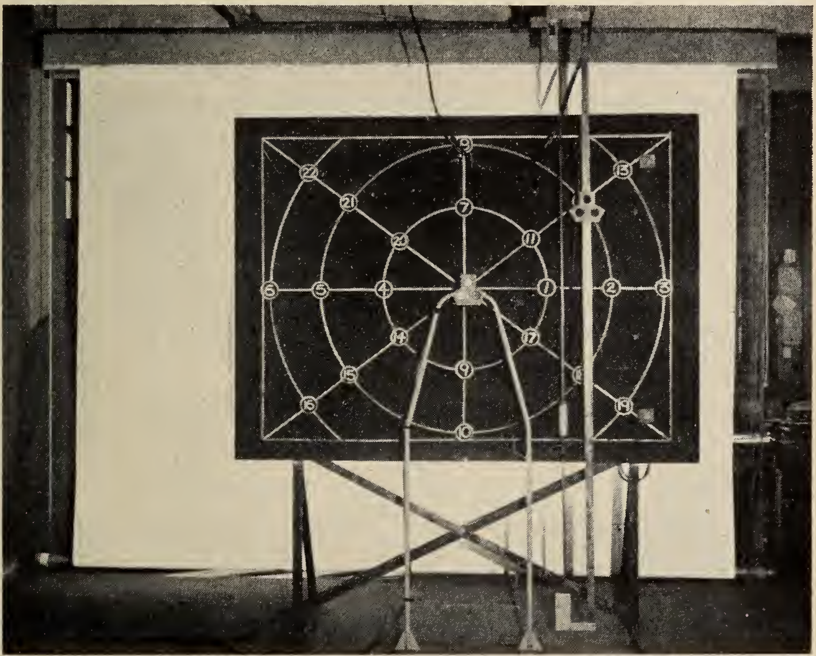

Fig. 7. Mechanically travelled Photo-cell.

illumination, total flux and diversity of the illumination reaching the screen can be calculated.

Triple photo-cell holders with accommodation for filters are provided both in the mechanically travelled unit and in the monitor unit. One of these holders carries a cell with a filter correcting the cell's colour response approximately to that of the average eye ; it consists of a two-component glass filter using Chance OY 12 and OY 4 filters of appropriate thickness.

The other two holders carry rectifier cells, one with a red, the other with a blue filter (Wratten Nos. 22 and 47 respectively). These two cells are used to detect changes in colour of the light illuminating the screen ; they are connected in opposition to each other to a galvanometer using a suitable resistance network, so that when the colour of the light is normal, the galvanometer reading is zero, but any disturbance causes the galvanometer to deflect in a direction and to an extent depending on the amount of colour change which the light has undergone. A selector switch enables the cells on either the monitor unit or the travelling unit to be connected to this galvanometer, so that changes of colour which may occur at any time during a test on any portion of the screen can be followed by switching in the galvanometer and observing its deflection.

9—Terminology.

For convenience, the familiar terms " brightness " and " footcandle " have been used throughout this paper, but it should be noted that " lumens per square foot " has now replaced " footcandle," and " luminance " should be used when the brightness referred to is photometric brightness.

REFERENCES

1. *J. Brit. Kine. Soc.*, **10**, No. 1, Jan./Feb., 1947, p. 37 ; **10**, No. 2, Mar./April, 1947, p. 68.
2. B.S. 1404-1947 : Screen brightness.
3. B.S. 230—1935 : Portable Photometers (visual type).
4. *Brit. Kine.*, **13**, No. 3, Sept., 1948, p. 82.
5. *J. Brit. Kine. Soc.*, **2**, No. 4, Oct., 1939, p. 226.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library

MANUEL DE SENSITOMETRIE. By L. Lobel and M. Dubois. 3rd edition. 216 pp. Paul Montel, Paris. 375 fr.

The English-speaking student of photography who wishes to study sensitometry beyond the scope of the standard omnibus handbooks (Clerc, Henney and Dudley, Neblette, etc.) is very badly served unless he has the advantage of having an intermediate grounding in physics and algebra.

The manual of sensitometry by MM. Lobel and Dubois is an example of a peculiarly continental phenomenon — an attempt to deal seriously with an important, but somewhat dry, photographic subject in terms, and in a form, which will appeal to the man of limited technical education without earning the scorn of the expert. That there is a market for such works is evidenced by the appearance of a third edition of this useful manual just four years after the issue of the second edition. The classic work in this field was, of course, Goldberg's " Der Aufbau des photographischen Bildes " which was a great success in its day.

The nearest approach in English to the work of Lobel and Dubois was—it is now out of print—an Eastman Kodak publication entitled " Photographic Sensitometry." This work was a reprint of a series of papers by L. A. Jones which appeared in the *Journal of the Society of Motion Picture Engineers* through 1931 and 1932.

There is room for the appearance of a new work in English—a translation of Lobel and Dubois' manual or the re-issue of a revised edition of Jones' " Photographic Sensitometry." In the latter case, may I suggest the inclusion of an introductory section for the benefit of those, and they are many, who are not familiar with the nature of logarithms.

G. I. P. Levenson.

THREE BRITISH SCREENPLAYS. Edited by Dr. Roger Manvell. Methuen. 10s. 6d.

The three screenplays published in this volume are *Brief Encounter*, *Odd Man Out*, and *Scott of the Antarctic*. However, there are differences between them. *Brief Encounter* has been edited so that it closely follows the completed film. *Odd Man Out* is the original screenplay as it was given to the actors and technicians ; footnotes tell where a scene was not included in the finished film, where added scenes were shot, and where material alterations were made during shooting. *Scott* has been specially prepared for the volume ; I imagine in this instance, as indeed must happen with most documentary type entertainment films, that a great deal of the film's success was due to post-production editing, and that the original screenplay would not have given the reader a clear impression of its final structure.

We are given at last an opportunity of a close study of the blue-prints for three British films that have won high praise and honour. To the technicians they are an insight into master minds of our industry. It is an illuminating experience and an opportunity every technician should take.

John Croydon.

LIGHTING FOR KINEMATOGRAPHY

A COURSE of Lectures under the above title will take place in the Main Theatre, Ealing Studios, Ealing Green, W.5, at 8 p.m. on Mondays.

The course will be opened on the 23rd October, 1950, by the President, Mr. A. W. Watkins, A.M.I.E.E., F.B.K.S., F.R.P.S. The first three lectures on October 23, November 6 and November 20, will be given by Dr. F. S. Hawkins, Ph.D., A.R.I.C., M.B.K.S., and will cover : Light Sources, Light Fittings and Measurement of Light, including :—

Luminous Flux, Illumination, Luminance and their Measurement—Distribution of Flux—Nature and Properties of Tungsten Filament Lamps, Carbon Arcs, Mercury Vapour Arcs and other Light Sources—Refraction, Reflection and Diffusion of Light—Limitations of Tungsten Filament Lamp Fittings, Carbon Arc Lamps, Mercury Vapour Arc Fittings and other Lighting Units — Measurement of Illumination on Sets—Effect of Colour Response of Different Film Stocks in relation to the Luminance of Objects—Colour Temperature—Colour and Colour Rendering Properties of Light Sources.

December 11 : "Pictorial Aspects of Photography" by Mr. Gilbert Adams, F.I.B.P., F.R.P.S.

Still Portraiture—Space Filling and Composition—Modelling—Lens *f* Value and Depth—Definition and Control of Focus—Variation of Format—Lighting for Colour Photography.

January 8, 1951 : "Motion Picture Lighting," by Mr. Max Greene, B.S.C.

Motion Picture Photography — High and Low Key Lighting — Modelling — Composition and Camera Movement—Building Up Lighting.

January 22 : "Deep Focus Photography," by Mr. Desmond Dickinson, B.S.C., M.B.K.S.

Lighting Requirements—Contrast Control—Lens *f* Value and Depth—Methods of Obtaining Very Deep Focus by means other than Stopping Down Lens.

February 5 : "Exterior Lighting—Day and Night," by Mr. Gordon Dines, M.B.K.S., A.R.P.S.

Day Photography with and without Booster Light — Night Photography with Artificial and Normal Lighting.

February 19 : "Lighting for Television," by Mr. R. D. Campbell, B.Sc., A.M.I.E.E. (of the B.B.C. Television Service).

Contrast Range required for Television Cameras and Lighting for Multiple Camera Positions and Requirements of Film for Television Transmission—Technique of Lighting for Television Films—Night Effects with Day and Artificial Light.

General Review of Lectures by Mr. F. A. Young, F.B.K.S., *President, British Society of Cinematographers.*

The charge for the Course will be 1 guinea for members of the Society and 2 guineas for non-members. The lectures have been specially arrranged for continuity and members are advised to make every effort to attend the whole series.

The British Kinematograph Society desires to express its appreciation to Sir Michael Balcon, Hon. F.B.K.S., and Major R. P. Baker, of Ealing Studios Ltd., for their courtesy in permitting these lectures to be given at the Ealing Studios, thereby enabling them to be of a demonstrative character.

TECHNICAL ABSTRACTS

Certain of the following abstracts are reprinted by courtesy of Messrs. Kodak Ltd. Most of the periodicals here abstracted may be seen in the Society's Library.

CARE AND PRESERVATION OF MOTION PICTURE FILMS

Photo. Revue, Sept., 1949, p. 142.

In tropical locations, motion-picture film may deteriorate unless it is shielded from excessive heat and humidity. Magazines are enclosed in sealed, metal-foil envelopes, while film supplied on reels is contained in cans sealed by adhesive bands. If the film is to be kept for only a short time before use, a temperature as high as 24° C. can be tolerated, but, for longer times, temperatures should be no higher than 10° C. Otherwise, additional exposure is required. Once the moisture-tight package has been opened, the film must be used and sent for processing without delay. Otherwise, the film should be enclosed in an airtight box and cooled in a refrigerator of the mechanical type. As a preliminary step, it may be necessary also to remove excess moisture by temporarily enclosing the film with a dessicant, such as silica gel. Processed films should also be shielded from high temperature and humidity, preferably by storage at 12° to 18° C. and 45 to 55 per cent. relative humidity. Humidification treatment is risky and is not recommended, but processed film may require dessication. Cleaning of processed films with a volatile film-cleaning liquid is recommended in order to lessen the danger of abrasion by dirt.

C. E. I.

M.Q. DEVELOPER

E. W. Hellendoorn, *Foto*, Dec., 1949, p. 413 ; January and February, 1950, pp. 7 and 42. (In Dutch.)

Hydroquinone is shown to have an appreciable effect on the degree of development in MQ solutions at *p*H 8.4. G. I. P. L.

PHOTOGRAPHY IN THE ROCKET-TEST PROGRAMME

C. H. Elmer, *J. Soc. Mot. Pic. and Tel. Eng.*, Feb., 1950, p. 140.

A survey of specialised camera equipment used for maintaining photographic records of rocket launchings. Film speeds of from 2 to 500 frames per second are used, and colour film is favoured. R. H. C.

UNDERWATER PHOTOGRAPHY

J. B. Collins, *Phot. J. (B.)*, Jan./Feb., 1950, p. 24.

The principal problem in submarine photography is the dispersion and absorption of light, which increase at either end of the spectrum. For artificial lighting, mercury or sodium is preferable to tungsten. Suitable types of cameras, sensitive materials and exposure meters are discussed. R. H. C.

COLOUR CORRECTION WITH COLOURED COUPLERS

W. T. Hanson, *J. Opt. Soc. Amer.*, March, 1950, p. 166.

The optical characteristics of coloured dye-forming couplers of a type suitable for use in colour films, such as Kodacolor or Ansco Color, are described. The effect of colour reproduction of the overlapping absorptions of the image dyes available for use in colour negative films can be eliminated by the use of coloured couplers which have the proper spectral-absorption characteristics. The rôle of the six masks which are found to be required by a number of the theoretical treatments of the problem of exact colour reproduction can be filled by coloured couplers having the proper spectral-absorption characteristics. The effect of coloured couplers on film speed is also discussed.

NOISE CONSIDERATIONS IN SOUND-RECORDING TRANSMISSION SYSTEMS

J. Soc. Mot. Pic. and Tel. Eng., Feb., 1950, p. 129.

Recent improvements in volume range of recording systems focus attention on background noise. Noise sources, both external to the system and internal, are examined in some detail and classified. C. V. L.


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THE TREND IN DRIVE-IN THEATRES

C. R. Underhill, Jr., *J. Soc. Mot. Pic. and Tel. Eng.*, Feb., 1950, p. 161.

Since 1933 over 1,000 drive-in theatres have been constructed in the United States. Picture size ranges up to 60 ft. in width ; problems of sound distribution are met by the use of " in-car " speakers, fed from special amplifiers. R. H. C.

A STURDY HIGH-QUALITY 16mm. PROJECTOR

G. T. Lorance, F. B. Dibble, and H. J. Reed, *J. Soc. Mot. Pic. and Tel. Eng.*, Feb., 1950, p. 171.

A 16mm. projector based upon the requirements of American Standard Z52.1 contains a number of novel features, in particular a cam-operated sprocket for the intermittent feed. R. H. C.

FROM THE OVERSEAS PRESS

Publications quoted may be seen in the Society's Library

FILM INDUSTRY OF THE WORLD

A survey of the world's film industry provides valuable statistics relating to 47 countries. The total number of kinemas in the world is 92,300, attracting annually 12,220 million patrons. The world's production of feature films last year was 1,809.

Film Français, Autumn, 1950.

FRENCH EXHIBITION OF KINEMATOGRAPHY

At the second Salon du Cinéma, held in Paris from October 5 to 15, a wide range of studio, laboratory and kinema equipment was displayed.

Tech. Ciné., Oct. 1950 ; *Film Français*, Autumn, 1950.

THE COUNCIL

Summary of meeting held on Wednesday, September 6, 1950, at 117 Piccadilly, W.1.

Present : Mr. A. W. Watkins (*President*), in the Chair, and Messrs. L. Knopp (*Vice-President*), E. Oram (*Deputy Vice-President*), H. S. Hind (*Hon. Treasurer*), D. Cantlay, F. G. Gunn, B. Honri, N. Leevers, R. E. Pulman.

In Attendance : Mr. R. H. Cricks (*Technical Consultant*) and Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. W. M. Harcourt, Rex B. Hartley, T. W. Howard and I. D. Wratten.

Death of a Fellow.—The President and Council received with profound grief news of the sudden death in Belgium of Mr. C. H. Champion, an old and valued friend of the Society.

Patron Member in India.—Mr. Y. A. Fazalbhoy had enrolled his Company, Messrs. General Radio & Appliances, Ltd., Bombay, as a Patron Member of the Society.

COMMITTEE REPORTS

Social Committee.—A tentative booking for a Dinner-Dance had been arranged at Grosvenor House, Park Lane, for February 15th, 1951.

1951 *Exhibition Committee.*—Other bodies had been approached on the proposal to arrange an Exhibition during the period of the 1951 Festival, but owing to lack of support it was decided not to proceed with the project.

Film Production Division.—Two matters of importance had been considered. First, the Divisional meetings arranged under the heading " Production Economics and the Studio Technician " ; nine meetings had been arranged, five of them joint meetings with the A.C.T. and four Divisional meetings. Second, the course on " Lighting for Kinematography," which would commence at Ealing Studios on October 23rd, at 8 p.m.—*Report adopted.*

Theatre Division.—Messrs. L. A. Blay, G. A. Jackson and H. Lambert had been appointed to serve on the Divisional Papers Sub-Committee. The position concerning the lecture programme had been reviewed. Of particular interest was the fact that Dr. Wells Coates had been invited to prepare a paper on the Festival of Britain Telekinema.—*Report adopted.*

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Sub-standard Film Division.—Plans in connection with the 16mm. Film Investigation were progressing and those approached had indicated their willingness to serve on the technical Committees with the exception of one film laboratory.—*Report adopted.*

Membership Committee.—Two main considerations were the long list of overdue membership subscriptions and applications for membership. Steps were being taken to obtain subscriptions in arrear, or alternatively, to ascertain the reason for their being so. Three applications for Membership, two for Associateship, and one for Studentship, were recommended.

Attention was drawn to the necessity for proposers of candidates for membership to see that carefully defined details, which complied with the regulations, were given on proposal forms.—*Report adopted.*

Branches Committee.—The position of the Sections was being considered and steps taken to obtain first-hand information of the views and requirements of members within the sections. The Newcastle Section had planned a programme of papers for the current session, which it was enthusiastically putting into effect.—*Report adopted.*

Fellowship Committee.—Nominations were considered for Hon. Fellowship and for Fellowship, and the names of those recommended for the conferment would be submitted later.—*Report adopted.*

Library Committee.—Mr. M. F. Cooper's resignation as Chairman of the Committee had been accepted with regret, and the recommendation submitted that Mr. R. J. T. Brown be appointed in his place.—*Report adopted.*

The meeting was then adjourned until September 27th.

THEATRE DIVISION — JOURNAL REPORTS

Members of the Theatre Division frequently complain that the subject matter of *British Kinematography* is of little interest to them. The reason for this is not difficult to understand.

The majority of meetings of the Theatre Division are of a demonstration type, and are not well suited to being reported in the Journal, the reading of the notes about them usually being a very poor substitute for attending the actual meeting.

The remedy for this lack of interesting matter in the Journal is, however, in the hands of the Theatre Division members, who are asked to send in written communications specifically chosen on subject matter suitable for inclusion in the Journal. An example appears in this issue (a paper by Dr. Hawkins and H. W. W. Losty). The Editor welcomes such communications as quite additional to the subject matter of reports of Theatre Division meetings. Furthermore, such written communications, when submitted by Associates, will be studied on their merits as theses for qualification for transfer from Associate tc Member.

S. A. Stevens,
Chairman, Theatre Division.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

J. P. J. Chapman has just completed a 16mm. Kodachrome film for Ganz & Co., Zürich. All the shots were taken at high level in the Swiss mountains.

Louis Mannix is now convalescing after an operation.

HANS LUDWIG BOHM

Killed September 18, 1950

Dr. Bohm, who was killed accidentally by an underground train, was for a number of years with Ufa, in Germany, and played an important part in the introduction of sound into German studios, and in the formation of the patents pool.

He came to this country in 1936, and founded a printing and publishing business. One of his companies published the book " Friese-Greene : Close-up of an Inventor," now being filmed. R.H.C.

Small announcements will be accepted from Members and Associates. Rate, 4d. per word, plus 2s. for Box No. if required (except for Situations Wanted). Trade advertisements, other than Situations Vacant, not accepted.

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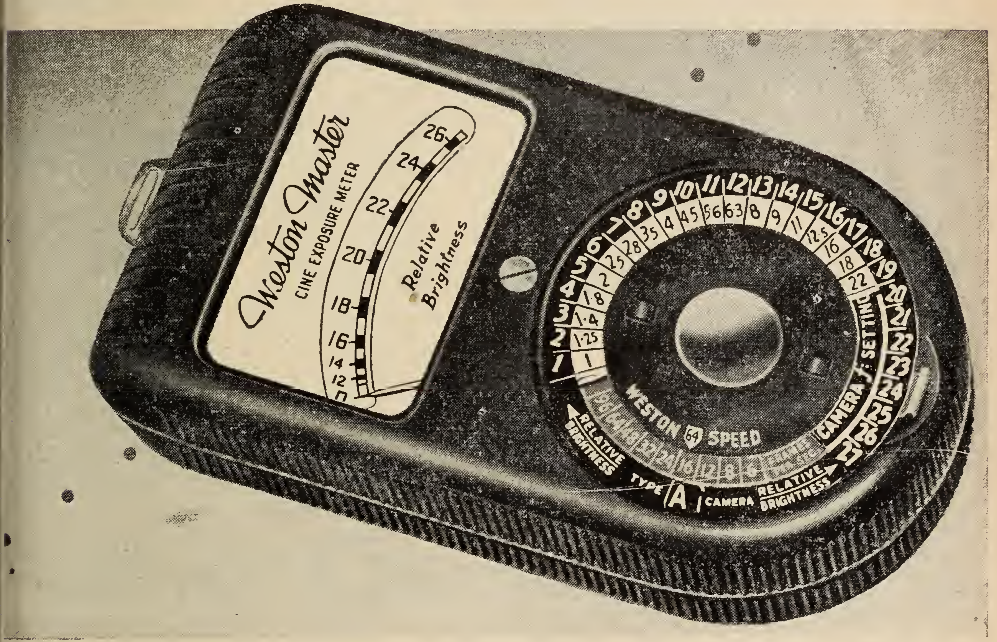

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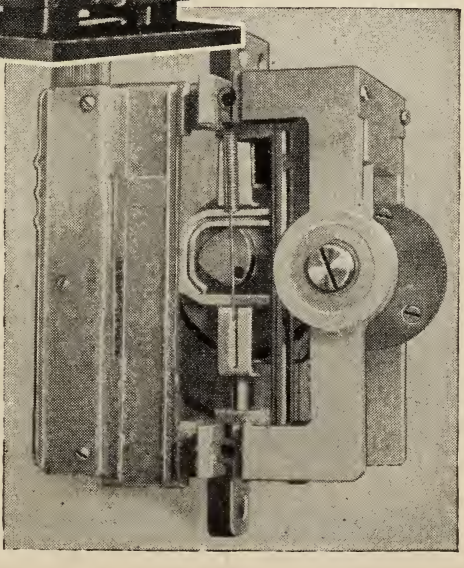

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SEVENTEEN, No. 5 NOVEMBER, 1950

A.G.D. West Memorial Lecture.

MOTION PICTURE FILMS FOR TELEVISION

Otto Sandvik* and T. G. Veal*

Communication No. 1360 from the Kodak Research Laboratories

Read by I. D. Wratten, Hon. F.B.K.S., F.R.P.S., to a joint meeting of the Royal Photographic Society, the Television Society, and the British Kinematograph Society, on May 2, 1950.

MOTION-PICTURE films are used in the television industry for two basic purposes : (1) for making motion pictures to serve as original programme material, and (2) for Kinescope photography of scenes which are televised from the original.

The extent to which motion pictures will be used for television programmes will be based on economical, operational, and technical considerations. The economics of direct televising *versus* the intermediate filming of the scene will not be discussed here.

I—FILMS FOR TELEVISION TRANSMISSION.

Television programmes on film have certain advantages over those produced by direct pickup, namely :

(*a*) Films can be distributed to stations not connected by regular station-to-station coaxial cable or radio relay networks.

(*b*) Film programmes can be produced by methods and techniques which have been developed to a fine art in the motion-picture industry. Direct television pickup of a play or a sequence of scenes suffers from many of the limitations common to the theatre or stage play, viz. :

(1) The number of sets in a television studio is strictly limited. Scenes to provide setting or atmosphere are usually either impractical or impossible.

(2) Fading from one scene into the next is difficult.

(3) The tempo of the action is limited by the change of scenes and costumes.

(4) Exterior scenes cannot be used freely with studio sequences, so that most special effects are impossible.

(5) Faking is difficult.

(6) A retake cannot be made to correct a mistake.

Thus, from the standpoint of convenience and scope of action, it is evident that the motion picture is a useful medium for a complete programme, or as a

* Eastman Kodak Company, Rochester, N.Y., U.S.A.

Fig. 1. Studio set showing in fine detail a set that does not reproduce well over a television system.

Fig. 2. Studio set showing large uniformly toned areas broken up by a pattern design.

means of supplying sequences or scenes that are either difficult or impossible to obtain with the television studio camera.

Fundamental Limitations.

The present discussion, however, will deal primarily with some technical aspects of motion-picture film characteristics for television. The performance of any picture pick-up device depends upon several basic properties of the medium or characteristic features of the system, namely :

(*a*) Sensitivity.
(*b*) Resolution or rendition of picture detail.
(*c*) Image inhomogeneity or random fluctuations.
(*d*) Tone reproduction or transfer characteristic.

These properties of motion-picture films and of television-system elements have been discussed extensively in the literature. Each of these properties depends, to a lesser or a greater extent, upon the others.

The relative sensitivities of motion-picture film and of the television camera tube are of practical importance primarily when, in case of adverse lighting conditions, one has the choice of using either medium.

Resolving Power.

A comparison of the detail-rendering abilities of the two media, on the basis of the limiting resolving power of the film and the number of television scanning lines, is of little significance. Detail which is just resolved under special viewing conditions corresponding to limiting resolution, probably does not contribute appreciably to picture sharpness. The criterion of satisfactory picture sharpness is that the image structure be sufficiently well resolved so that it can be seen easily under normal viewing conditions.

The vertical resolution in a television picture is not generally equal to the number of scanning lines within the picture area since it depends on the composition of the subject. It has been shown that, on the average, 64 per cent. of the picture elements are reproduced correctly in the scanning process. Moreover, the vertical and the horizontal resolution in a television system are not necessarily equal. This depends on the over-all effective band width of the television system, that is, the frequency-response characteristic of the camera tube, the video amplifiers in the camera, the transmitter, and the receiver. The frequency-response characteristics can be modified by appropriate electrical network in the video amplifiers. Thus, as the response of the high frequencies, which carry the fine image detail, is increased, the rate at which the resolution of the fine image structure fails can be modified accordingly, as it approaches a limiting value.

The picture sharpness which can be obtained in a well-adjusted closed-circuit television system using a flying-spot scanning system and a band width of $4\frac{1}{4}$ Mc/s, probably approaches that of average commercial quality 35mm. motion pictures. At present the quality of some pictures on the home television receiver is more nearly comparable to that of 8mm. motion pictures.

When comparing the picture sharpness of the two media, or the detail that the eye can see, there appears to be one notable difference, namely, the viewing distance relative to the size of the picture. A motion picture can be viewed with comfort, without annoying disturbances owing to graininess, at a distance equal to about twice the width of the picture. The preferred viewing distance has been found to be about $3\frac{1}{2}$ times the picture width. A limited survey indicates that a critical observer prefers to view a television picture at a distance equal to about eight times the picture width. Since this is more than twice the distance that the average eye fails to resolve the scanning lines, the amount of detail that the eye can see is reduced proportionately.

Granularity and "Noise."

The developed photographic image is composed of individual silver particles called "grains." When this image is viewed through a microscope, or is projected on a motion-picture screen and observed from a position close to the screen, the silver grains are visible. This grainy pattern, which is called "graininess," generally is more pronounced in a high-speed film than in a low-speed film. As a result of this grainy structure of the developed photographic image, there is a random fluctuation in the luminance of the motion-picture image on the screen.

Luminance fluctuations of a similar nature are present in a television picture, even when reproduced directly from the original scene, that is, the luminance of the scanning lines on the Kinescope screen fluctuates in a random manner. The phenomenon in this case is usually called "noise," a term borrowed from the field of sound communication. The random luminance fluctuations in the television picture are due to random fluctuations in the video signal and may have their origin either in the camera tube of the storage type or in the video amplifier.

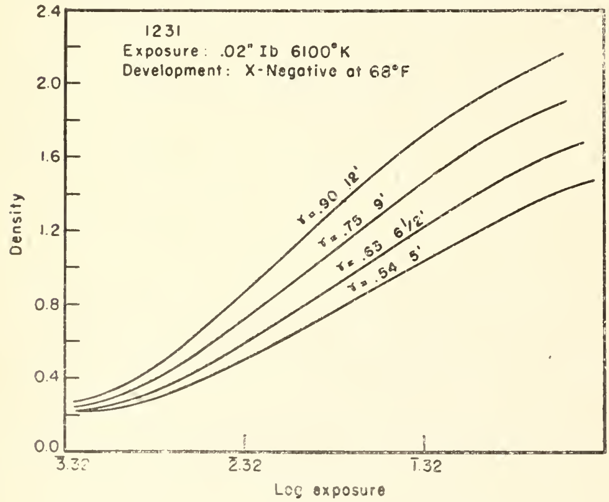


Fig. 3. A family of H and D Curves of a typical negative emulsion. Eastman Plus-X Panchromatic Negative, Type 1231.

The factors which determine the visibility of random fluctuations, due to the grain structure of the photographic image and to spurious signals or noise in the television system, have been discussed in the literature. Under certain conditions, the magnitude of the fluctuations is sufficiently large to affect the smoothness of texture of both the motion-picture and the television image. Since the graininess of the film will add to the noise generated within the television channel itself, fine-grain emulsions and 35mm., rather than 16mm., films should be used whenever possible.

Reproduction Characteristics.

The reproduction of the luminance values in a scene by the photographic process has been investigated extensively in the field of photographic tone reproduction. Before discussing this subject in its relation to the transfer characteristic of a television system, some of the sensitometric characteristics of a photographic emulsion will be reviewed briefly.

The usual method of determining the sensitometric characteristics of a photographic material is to expose it to a known quality and known quantities of radiation, develop it under standard conditions, and measure the densities which result from the various exposures. The results are expressed in graphical form by plotting curves of the density as a function of the logarithm of the exposure. Numerical constants are derived from these curves which are used in specifying the characteristics of the material.

When several similar series of exposures are made and are developed for different lengths of time, a family of curves results, as shown in Fig. 3. These are the sensitometric characteristic curves, more popularly known as the H and D curves. The slope of the straight-line portion of these curves is called " gamma." It will be noted that the slope of these curves increases with the length of time of development ; therefore, the difference in the densities corresponding to two successive exposure values increases with development time.

Gamma and Contrast.

The luminance relations between the different areas of the projected positive image should be the same as those between the corresponding areas in the object. This can be accomplished over a considerable range by developing the negative and the positive to the proper gammas. In general, the product of

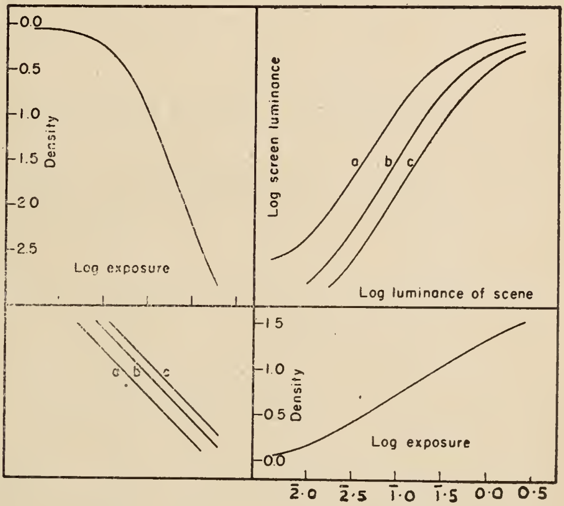


Fig. 4. A tone reproduction diagram of the photographic process.

the gammas of the negative and the positive should be equal to unity. However, owing to the difference in the viewing conditions of the original scene and the projected picture, and to some other factors which will not be discussed here, the gamma product should be somewhat greater than unity. When the gamma product is too low, the contrast of the picture is also too low and the picture appears " flat " ; conversely, when the gamma product is too high, the contrast is also too high.

It should be noted, however, that gamma and contrast are not synonymous. The contrast of the picture depends upon other factors, especially upon the lighting of the subject. The contrast in a photograph of a scene taken on a bright, sunny day will be greater than that in a photograph of the same scene taken on a cloudy day, when the two are developed to the same gamma.

Tone Reproduction.

The process of photographic tone reproduction can be illustrated graphically by means of the tone-reproduction diagram in Fig. 4. This figure is only illustrative ; for a more complete treatment of photographic tone reproduction the reader may consult references 18 and 19 in the bibliography.

The negative characteristic developed to a gamma of 0.60 is shown in the lower right-hand quadrant. The straight line in the lower left-hand quadrant represents the printer light. Its slope shows that the logarithm of the exposure of the positive is proportional to the negative density. A shift of this line up or down in the diagram corresponds to a change in the printer light intensity, and determines the density in the positive obtained through a given negative density. In general, the choice of printer light intensity depends on the density level of the negative and the nature of the scene. Sometimes a very dense or a very light print is made to obtain special effects. The characteristic of the positive film is plotted in the upper left-hand quadrant. The resultant over-all reproduction curve in the upper right-hand quadrant relates the log luminance of the scene to the positive density.

Camera Tubes.

The tone reproduction over a television system depends upon the transfer characteristic of the transducers, that is, the photosensitive device which transduces light into electric current, and the Kinescope which performs the inverse process. The phototube used in flying-spot systems, and the image dissector, are substantially linear devices. The Image Orthicon tube is

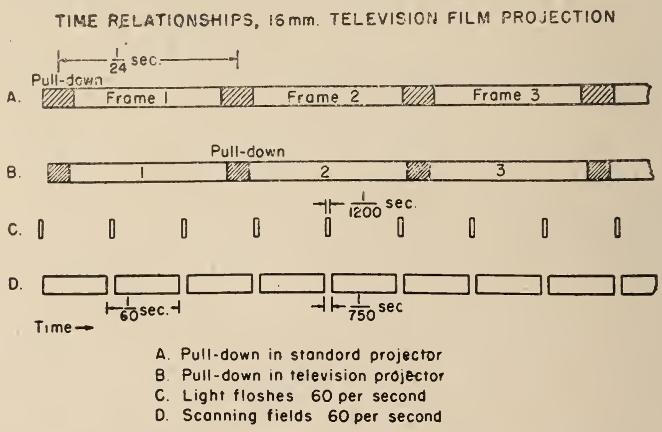


Fig. 5. Time relationships of 16mm. television film projection.

approximately linear under certain conditions of illumination. The relation between the Iconoscope mosaic illuminance and the current output is not a linear function ; the slope of the output-input characteristic decreases as the illuminance is increased, as will be shown later.

Both the Image Orthicon and the Iconoscope are storage-type tubes, that is, when the photosensitive mosaic is exposed to light for a short period of time, an electric charge is established on it. This charge is retained for some time until it is removed by the cathode-ray scanning beam. Owing to its low sensitivity, the Iconoscope has been superseded by the Image Orthicon for " live " pickup use. It is, however, now used extensively in the United States as a pickup tube in television film cameras.

Conversion of Frame Rates.

The ability of these tubes to store the electric charge, which represents the video signal, is a useful property in American television film cameras. First, since the picture frame rates are 24 and 30 frames per second, for film and television respectively, some means must be used for obtaining 30 television frames from the 24 film frames. Second, in order to obtain a complete television signal, the mosaic of the film-camera pickup tube must be scanned almost continuously. The only significant break in the scanning process is the interval during which the beam returns from the bottom of the picture to the top. During this interval, 1/750 second, every 1/60 second, one for the lace and one for the interlace, the picture is blanked out. Since it is not practical mechanically to advance the film during this short interval, some other method must be used.

One common method is the use of short light flashes, so timed that the film picture is projected on the pickup tube mosaic for only 1/1200 second, every 1/60 second. These flashes occur during the retrace time. Since the pickup tube stores the charge, the mosaic can be scanned during the interval between the flashes. The flashes are provided by a rotary shutter placed in the light beam. A small slit on its periphery admits the light flash. The shutter is driven at a speed of exactly 3,600 r.p.m. by a special 3-phase synchronous motor which locks in the correct phase relation with the cycle of operation in the television system. The cycle of operation is illustrated diagrammatically in Fig. 5. The required television frame rate of 30 per second is obtained by illuminating one motion-picture frame twice and the next frame three times, alternately. In order to employ this 2-3-2-3- scanning sequence successfully, the pulldown time must be shorter than that commonly used in standard projectors, as illustrated in the diagram.

Transfer Characteristics.

The combined or the over-all transfer characteristic of the Iconoscope and the Kinescope can be determined by a graphical method similar to that illustrated in Fig. 4. Owing to the dependence of the Iconoscope characteristic upon the illuminance and to the bewildering maze of knobs and controls at the camera, the monitor, and the receiver, each of which affects the picture quality, a transfer characteristic must be associated with a set of conditions.

A typical transfer characteristic of log output current as a function of the log illuminance in foot-candles on the Iconoscope mosaic is shown in the lower right-hand quadrant in Fig. 6. A linear video amplifier is represented by a straight line in the lower left-hand quadrant. This relates the log input voltage to the control grid of the Kinescope with the log output signal of the Iconoscope. The brightness of the Kinescope screen is a power function of the applied signal voltage ; the exponent varies between two and three, according to the particular type of Kinescope tube. The relation between log luminance in foot-lamberts and the log grid voltage of a Type 10BP4 Kinescope is shown in the upper left-hand quadrant. The combined transfer characteristic is shown in the upper right-hand quadrant.

The conditions were selected so that a highlight illuminance of 60 foot-candles on the pickup tube mosaic was reproduced at a luminance of 20 foot-lamberts on the Kinescope screen. This screen luminance is considerably higher than that normally used for either 16mm. or 35mm. film projection. The luminance level at which the Kinescope is operated depends upon the light level in the room, and to a great extent upon the preference of the observer. There is considerable evidence to indicate that many observers prefer to view an image of rather high brightness.

Tone Compression.

The combined transfer characteristic in Fig. 6 shows considerable compression of the luminance scale in the highlight region. Although the particular set of conditions used to obtain this curve shows no compression at low luminance values, it is generally recognized that shadow detail suffers from inadequate tone scale.

In other words, the television reproduction, like the normal photographic reproduction, introduces some compression at both ends of the luminance scale, that is, both in the highlights and in the shadows. It has been found that a certain amount of highlight and shadow compression in the photographic process is desirable, and the characteristics of the negative and the positive have been modified from time to time, as indicated by experience, so that the tone-reproduction characteristic obtained with present materials probably represents a very good over-all compromise. However, when this characteristic is combined with the over-all transfer characteristic of the Iconoscope and the Kinescope, the highlight and to a lesser degree the shadow compression is more than is desirable.

It would seem desirable, therefore, to use films for television reproduction that introduce less compression than the regular films used for normal motion-picture projection. The desired modification in the over-all tone-reproduction curve can be introduced by the necessary change in the characteristic of either the negative or the positive. However, since the positive, which is used for television reproduction, contains the sound record as well as the picture, appreciable change in the characteristic curve of the positive film would require special sensitometric characteristics or sensitometric conditions for the negative sound-track. It would be more practical, therefore, to introduce the modifica-

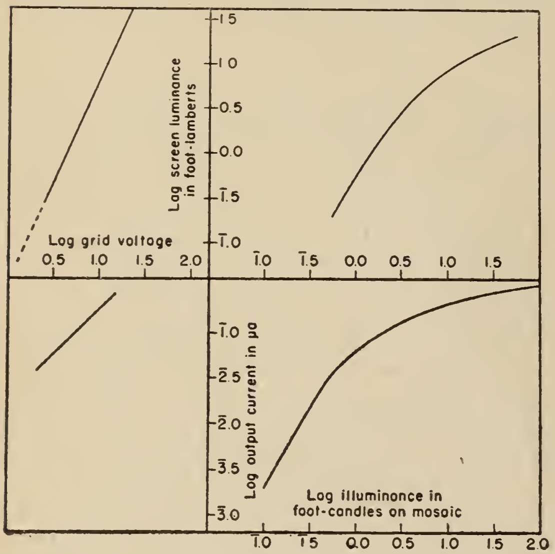


Fig. 6. A tone reproduction diagram or transfer characteristic of the Iconoscope-Kinescope combination.

tion by using a special motion-picture negative film by an intermediate duplicating, or by special printing processes.

Sensitometric Requirements of Films for Television.

If one assumes that the over-all tone-reproduction characteristic of a television image reproduced from film should be similar to that of film viewed directly on a motion-picture screen, the sensitometric characteristic of the negative can be determined graphically as shown in Fig. 7. The positive characteristic is shown in the lower right-hand quadrant, the transfer characteristic of the television system alone is shown in the upper right-hand quadrant, and the lower left-hand quadrant shows the negative characteristic required to obtain an over-all tone-reproduction characteristic similar to that of film alone as shown in the upper left-hand quadrant. This negative characteristic would compensate for the highlight compression for one given set of operating conditions.

The fact that different operating conditions probably require different negative characteristics implies that control of the sensitometric conditions and the television system characteristic is critical, and may impose definite limitations to the amount of compensation that it is practical to use. Further studies are required to decide whether the use of special motion-picture films or of non-linear circuit elements in the video amplifiers is the better solution of the problem.

A considerable amount of work has been done to determine whether the normal studio and laboratory practices or some modifications of these practices are more suitable for television reproduction. These investigations include studies of the most suitable type of studio lighting and the exposure and the development of the negative and the positive.

Variation of Positive Characteristics.

Many of the motion pictures used for television were not produced primarily for that purpose. In this case the sensitometric characteristics of the negatives are fixed, so that any modifications in the tone quality must be introduced by a special duplicating process, by masking, or by exposure, and/or development of the positive, substantially different from average motion-picture practice.

To illustrate the effect of varying the contrast in the positive by changing the

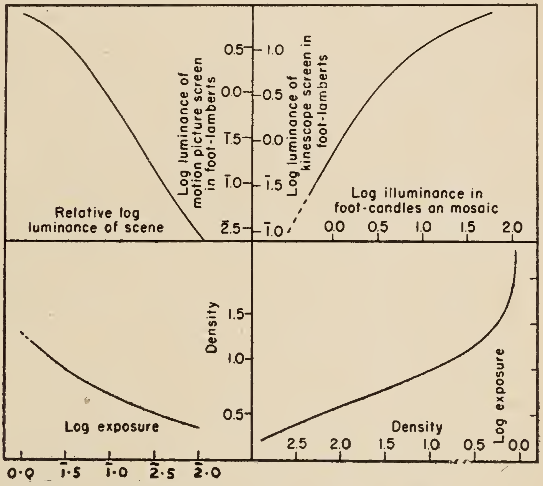


Fig. 7. The over-all transfer characteristics of the combined television and film process.

development time, a series of prints was made of a normal negative and developed to gammas of 2.5, 2.0, 1.5 and 1.0. The exposure of each print was adjusted to obtain the best print quality when viewed under normal projection conditions. These were reproduced over a closed-circuit television system and the images of a Type 10BP4 Kinescope tube were photographed. This is not a very satisfactory method of comparing quality, owing to the degradation it suffers in each subsequent copying operation. These successive degradations in quality minimize the differences which are noted when viewing the image directly.

Of the four prints, the two developed to the higher gammas reproduced most faithfully. Accordingly, two more prints were made, one printed two printer-steps light, and the other, four printer-steps light, and developed to a gamma of 2.5. These prints were reproduced and photographed on the Kinescope. (*Slides of all six prints were shown in the lecture.*) The signal-to-noise ratio in these pictures was less than that of the normal print, and the tone reproduction was not considered as good.

Effect of Negative Contrast.

Results of similar tests indicate that " normal " prints of low-gamma negatives do not improve the reproduction over a television system to the extent desired. A series of 16mm. motion pictures was made under similar, low-contrast lighting conditions from which a series of prints was made at four different gammas. The lowest gamma was 0.97, and the others were 1.50, 2.04, and 2.50. A number of prints were made from each negative, starting with a light print and gradually increasing the printer light intensity until a very dense print was obtained. These prints were reproduced over a closed-circuit system, and the print density which gave the best picture quality was selected from each gamma. The minimum and the maximum densities were 0.57 and 1.77, 0.48 and 2.04, 0.35 and 2.46, and 0.28 and 2.58, for the gammas of 0.97, 1.50, 2.04, and 2.50, respectively.

Another method which appears promising as a means of obtaining better television-picture reproduction, and which is gaining wide commercial acceptance, is the use of low subject-lighting contrast. This method also has the advantage that it involves no departure from standard practice in the processing laboratory.

Lighting Requirements.

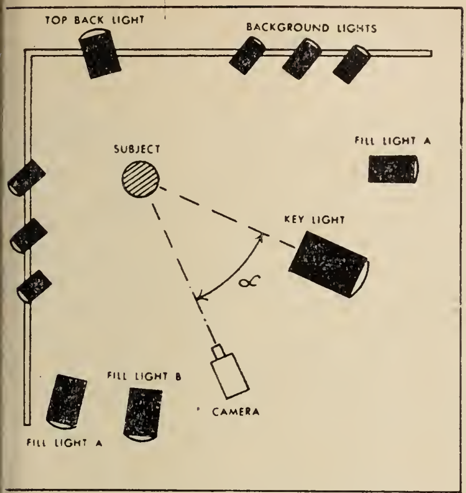
Typical lighting setups showing the placement of the lights in relation to the subject and the camera are shown in Figs. 8 and 9. The balancing light used to control contrast, usually referred to as the " fill-light," should give an illuminance level having a definite ratio to the key-light. The key-light is that light source used to illuminate the highlight area of the subject of greatest interest, and this area is the one on which the exposure is based. The ratio of fill-light to key-light illumination may be measured conveniently by means of photo-electric exposure meters which are equipped to measure *incident* light. Such meters are used at the position of the subject and are pointed at the light source. When measurements are made in this manner, the ratio of fill-light to key-light illumination is called " lighting contrast." The key-light illuminance should be checked after the fill-lights have been arranged.

It should be noted that the term " lighting contrast " is not synonymous with the terms " subject contrast " and " subject brightness range." The true subject contrast or subject brightness range is usually much higher than the lighting contrast, since it takes into account the different luminous reflectances of the various elements of the scene. It can be measured accurately only by means of a flare-free telescopic type luminance photometer, which measures a very small area and which allows the instrument to be situated at a sufficient distance so as not to obstruct any light falling on the subject.

Lighting Tests.

As a practical approach to the problem, it is possible to make luminous reflectance readings of various areas of the scene with exposure meters which are equipped for making reflectance measurements. The readings obtained with these meters do not, of course, give a measure of the true subject luminance range because of the greater angular response of the meters and because of the possible creation of shadows in making the measurements. These reflected-light readings are, nevertheless, very useful in roughly determining whether or not the various areas of the subject will be rendered correctly by the photographic material.

A series of pictures was made on 16mm. film, in which only a single fill-light and a single key-light were used to illuminate the main subject. No top-light was used and the back-lights illuminated the background only. The key-light illumination was constant for all contrasts. Both the negatives and the prints were developed to normal gammas. (*Kinescope photographs of these pictures were reproduced as slides in the lecture to illustrate the appearance of the pictures on the image tube.*) The lighting contrasts were 1 to 1, 1 to 2, 1 to 3, 1 to 4, 1 to 8, and 1 to 64, respectively. Although the pictorial quality was



LIGHTING CODE

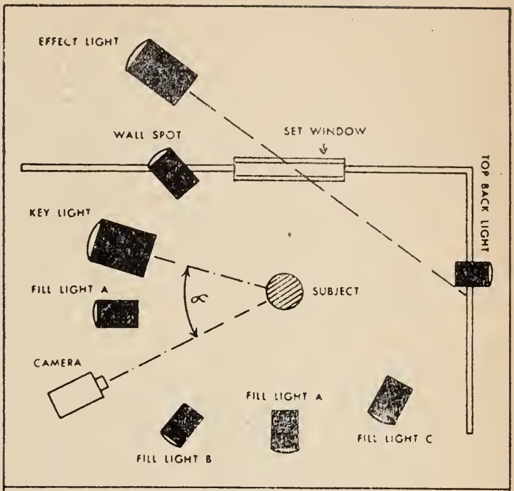
Y LIGHT—5000-watt Fresnel placed at angle ∝ (less than 45°) from camera and at higher elevation than camera so as to break shadow between nose and upper lip

L LIGHTS—Diffused, 2000- or 5000-watt Fresnel.
A. Placed at eye level
B. Placed lower than eye level.

P BACK LIGHT—Diffused, 2000- or 5000-watt Fresnel.

CKGROUND LIGHTS—Diffused or not, depending upon dramatic effect desired 750- or 1000-watt Fresnel, mounted on top of scene flats

Fig. 8. Typical studio lighting arrangement.



LIGHTING CODE

KEY LIGHT—5000-watt Fresnel placed about 24" above subject's eye level and at angle ∝ (less than 45°) from camera

FILL LIGHTS—Diffused, soft, 2000-watt Fresnel.
A. Placed at eye level.
B. Placed below subject's waistline
C. Placed above for background control.

TOP BACK LIGHT—Diffused, 2000-watt Fresnel

WALL SPOT—Diffused, 2000-watt Fresnel for background control.

EFFECT LIGHT—120-amp. Arc Fresnel for window effect on background.

Fig. 9. Typical studio lighting arrangement for window effect lighting.

rather poor, due partly to over-simplification in lighting, it served to illustrate that a lighting contrast between 1 to 2 and 1 to 3 results in the better tone quality. At the lowest contrast, again due partly to over-simplification in lighting, the subject has the appearance of a mannikin or a wax figure. Above 1 to 4, both highlight detail and shadow detail are lost.

General Photographic Requirements.

The subject matter should be photographed as large as possible but should not unduly crowd action and movement of characters. The most pleasing reproduction on the receiver screen is obtained from close-ups, and they should be used as frequently as possible. Medium shots give just acceptable reproduction, while long shots give rather poor reproduction. It is necessary, of course, to include some long shots in order to obtain the essential continuity in terms of transition, location, and dramatic narration of the story. The need for numerous close-ups is emphasized if one constantly visualizes reproduction in terms of the small viewing screen. On the average, most receivers are equipped with rather small screens, compared with screens commonly used for projection of home motion pictures.

In general, the stage sets may be smaller than those used for conventional motion-picture productions because of the need for many close-ups and the preservation of background detail. Fine or delicate detail in background, clothing, furniture, accessories, and all properties, such as illustrated in Fig. 1, should be avoided. Instead, large patterns with sharp changes in contrast, as shown in Fig. 2, should be used. The patterns or the detail should be of larger size so that they will be clearly visible on the television receiver screen.

II—KINESCOPE PHOTOGRAPHY.

A recent development in television has been the perfection of cameras that photograph the image on the picture tube and simultaneously record the sound. This process is known as "teletranscribing" or "Kinescope recording," and is a step forward in creating a nation-wide network without the use of a coaxial cable or of microwave links. The teletranscription method of networking permits television stations in the smaller-populated centres to carry top-quality metropolitan programmes at a cost commensurate with their operational budget. At the same time, the advertiser is enabled to procure nation-wide coverage of all markets with his television programme. The films can also be used in sales promotion and demonstration rooms of retail dealers for sales promotion and entertainment.

These films can be used to protect the station owner and the advertiser in case of litigation; such films are not, at present, required by the Federal Communication Commission in the United States.

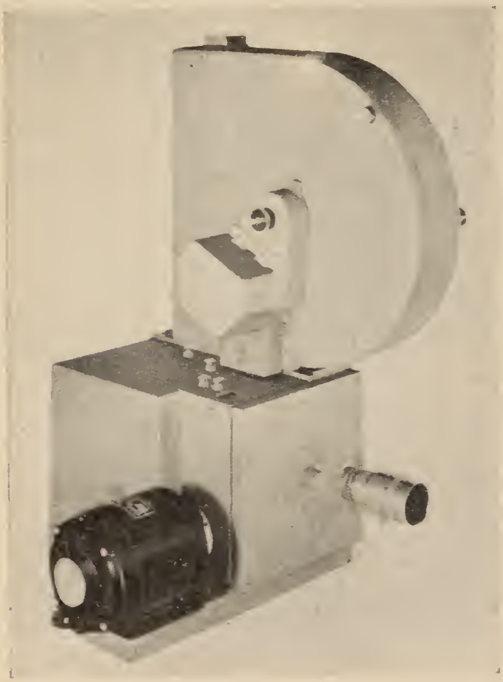


Fig. 10. Eastman Television Recording Camera, Model 2.

Owing to the four different time zones in the United States, coaxial cable or radio relay network between the east and west coasts is not a complete solution to the problem of nation-wide coverage with a network programme. For example, a television programme originating in the Los Angeles area at 10.00 p.m., Pacific Standard Time, transmitted to New York City over a network circuit and broadcast there simultaneously, would enjoy a very small audience since the time in New York City would be 1.00 a.m., Eastern Standard Time. When this programme is recorded on motion picture film by Kinescope photography and shipped to New York City, the show can be televised in that area at a more propitious hour.

Another use for Kinescope photography is in theatre television programmes, where news and special events are transmitted to the theatre, recorded on film, rapidly processed, and projected, either immediately or as a newsreel after the feature picture. This method of theatre television enables the theatre management to present and plan their programmes without interruption and discontinuity.

Cameras for Kinescope Photography.

The cameras that are required to photograph the 30-frame television picture on to 24-frame film must, of necessity, be precision instruments. One of these cameras is shown in Fig. 10. It is a 16mm. camera driven by an 1,800 r.p.m. synchronous motor usually powered from the same 110-volt A.C. source as the television station's synchronizing generator. The camera is supplied with a 50-mm. Kodak anastigmat lens which is focused on to a 2.5- by 3.5-inch television picture on the face of a 5-inch Kinescope tube. The film-transport mechanism utilizes an 8-tooth pull-down sprocket operating directly below a nylon film gate, highly polished to minimize gate friction. The camera shutter has a closed-shutter angle of approximately 73 degrees, shown in Fig. 11.

In the transfer of 30-frame television pictures on to 24-frame film it becomes necessary to utilize six television frames for film pull-down time. This requires the camera to combine the film picture precisely from two television fields in every other film frame, as shown in Fig. 12, that is, film frame No. 1 is exposed in exactly 1/30 of a second and includes information from television fields No. 1 and No. 2. During the pull-down time of film frame No. 2,

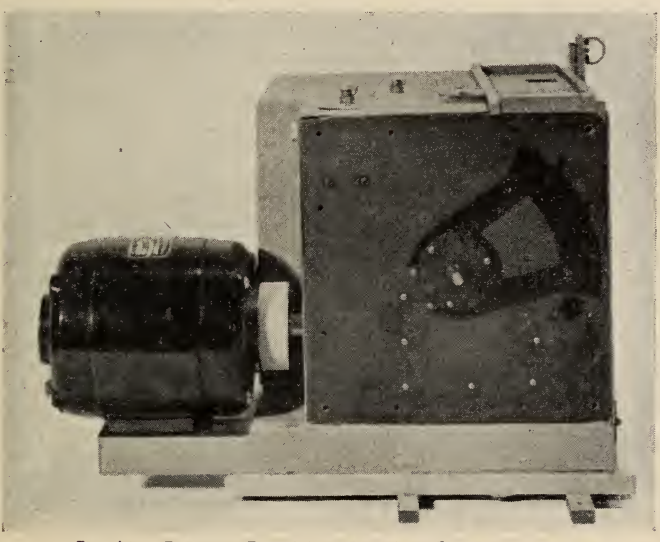


Fig. 11. Eastman Television Recording Camera shutter.

approximately one-half of television field No. 3 has passed, and the remainder of this television field is recorded on film frame No. 2 as is television field No. 4 and part of No. 5 to complete this film frame. This means that film frame No. 2 has been combined in the middle of the picture. Film frame No. 3 is recorded from television fields No. 6 and No. 7 without being combined from two television fields. Again, the film must be moved to film frame No. 4, which is recorded from part of television field No. 8, all of field No. 9, and part of field No. 10, and so forth, each successive frame being combined in the centre of the frame.

Frame Combine Matching.

To accomplish the combine in the centre of the picture and eliminate banding or combine marks, it is necessary, after the correct lens opening has been ascertained by test exposure recordings, to reduce the shutter angle to minimize shutter banding. The shutter is normally supplied too large, allowing for adjustment. When negative film is used, banding will probably be recognized on the film as a light streak across the film frame. This light streak indicates that the television scanning lines are not meeting and that a closed shutter angle of less than 73° is necessary to reduce the banding. The proper adjustment of the shutter under these conditions is usually to an angle less than 73° but greater than 72°. This precise adjustment is made by removing a few thousandths of an inch from the trailing edge of the shutter and making exposure tests following each adjustment until no banding can be detected in the picture frame, as seen in Fig. 13.

The exposure time of each film frame must be accurately determined and must include the exact number of television scanning lines in two television fields or one television frame, which is 525 lines less those blanked during retrace time.

Electronic Shutter.

Several attempts have been made to utilize an "electronic shutter," that is, to blank the picture information during the pull-down of the film, and to include just sufficient lines to obtain the frame combine in the picture. Theoretically, this appears to be the ideal method of obtaining a perfect picture utilizing the exact number of television lines to complete the spliced film-frame. Unfortunately, this was not the case ; with the electronic shutter in the earlier

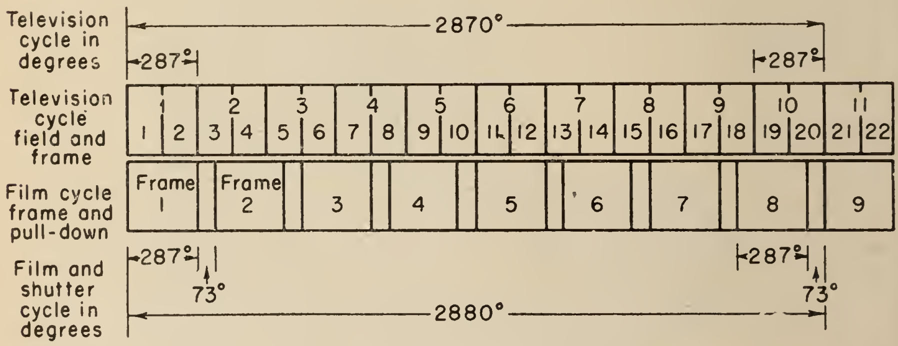


Fig. 12. Shutter action of television recording cameras.

experimental stage there was always noticeable banding, regardless of blanking adjustment. However, at present there are cameras operating with electronic shutters that are very satisfactory. One of the advantages of the mechanical shutter over the electronic shutter is the vignetting effect obtained at the combine in the film of the two television fields. While it is difficult and time-consuming to adjust a mechanical shutter to reduce banding, it is, to date, the accepted method by which satisfactory results are obtained.

Cathode-ray Tube for Photography.

The cathode-ray tube that has been universally accepted for Kinescope photography is a 5-inch, flat-face tube using electro-magnetic deflection and electrostatic focusing. This tube features a new electron gun having superior modulation characteristics and is adapted for high beam current.

The phosphor used in the tube is one of a new series of materials recently developed in the P-11 group, and will withstand the high beam current better than previously developed phosphors. It is blue in colour, peaking at approximately 4600A in its spectral-energy characteristics, and has an extremely short phosphorescence decay.

The decay time of the phosphor from its peak brightness to the 10 per cent. of maximum point is about 0.3 millisecond. The persistence of the radiation is sufficiently short to prevent " carry-over " from one frame to another, which is dependent to some extent upon the current density in the focused spot.

Definition and Contrast.

An ever-present factor to be considered when photographing a picture from a Kinescope is the loss of definition when it is operated at a high brightness level. The decrease in definition is caused by the defocusing of the electron beam exciting the phosphor. This defocusing can arise from non-uniform fields, whether electric or magnetic, or by variations of electron velocity in the beam. The electrons emitted from the cathode in the electron gun leave the cathode at different velocities, and these differences in velocity are preserved as the electrons pass through the gun. Since the amount of deflection depends upon the velocity of the electrons, a beam composed of electrons having a range of velocities will suffer a corresponding range of deflections. The beam is spread out into an elliptical cross-section, with the long axis in the direction of the deflection, instead of remaining in a sharply defined spot.

Fig. 13. A photograph from television Kinescope 16mm. negative, Type 5373 emulsion.

A factor which affects contrast, and which must be considered when a Kinescope is to be photographed, is its signal-to-light relationship or its transfer characteristics. When its control-grid voltage is plotted against the second anode current, the curve obtained will straighten out to some extent as the second anode voltage is increased. Yet the second anode voltage cannot be increased beyond the saturation of the phosphor with beam-current density. Other losses of contrast beside phosphor saturation are scattering and internal reflections of light from the walls of the tube. However, this has been reduced to a minimum by placing a thin aluminium coating over the phosphor within the tube.

Tube Luminance and Exposure.

The highlight luminance of the 5WP-11 Kinescope, when operated at a second anode potential of 27 kv and a second anode current of 30 microampères, will be approximately 150 foot-lamberts when adjusted for best pictures, which is adequate light for exposing slower positive and sound-recording types of emulsions. The intrinsic luminance of the scanning spot is exceedingly high and may attain a highlight luminance of several thousand foot-lamberts.

The exposure of the negative film is usually determined prior to the adjustment of the shutter. The shutter is adjusted for minimum banding at the aperture setting to give proper exposure on the negative. The procedure followed in obtaining a correct negative exposure is to use a plain raster on the Kinescope, such as would be obtained by the use of the blanking signal without picture modulation. The brightness of the raster is varied by means of the video gain control. The beam current may be measured with a microammeter. Since the brightness of the tube is dependent upon the beam current and the accelerating voltage, this beam-current measurement serves as a measure of the luminance.

A series of exposures may then be made by varying the beam current in logarithmic steps. After the film is processed to the recommended gamma, the density may then be read on a densitometer and plotted against the logarithm

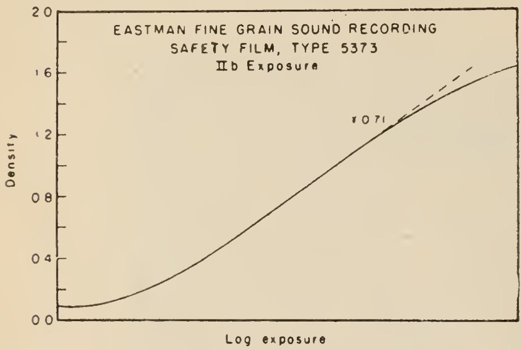


Fig. 14. H and D Curve of Eastman Fine Grain Sound Recording Safety Film, Type 5373, as used in Kinescope recording.

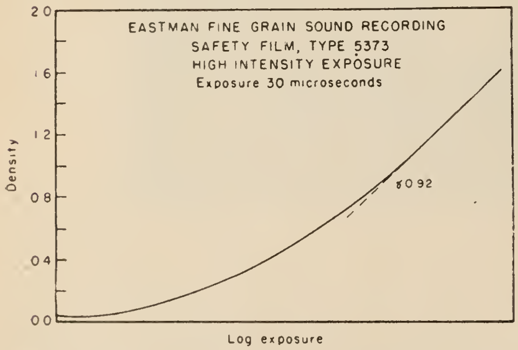


Fig. 15. H and D Curve of Eastman Fine Grain Sound Recording Safety Film, Type 5373, when subjected to high-intensity exposure.

of the beam current. For a negative material which has been developed to a gamma value of 0.65, the negative density range normally made use of in the recording of a picture image is from 0.20 to 1.4. A beam current which gives an average density of around 0.8 to 0.9 might, therefore, be considered as providing an average luminance level corresponding to that of a picture tube image which will give an approximately correct exposure. Using this beam current as a starting point, a series of exposures over a smaller range may then be made with picture modulation on the tube, in order to arrive at an average exposure value which will be satisfactory for various types of subject matter.

Film Stocks.

Either a negative or a positive picture may be obtained on the face of the Kinescope simply by reversing the phase of the signal presented to its input grid. The procedure generally used is to photograph a positive-picture tube image on Eastman Fine Grain Sound Recording Safety Film, Type 5373, or other similar types. This film offers the advantages of fine grain, low cost, adequate speed, and can be handled and processed under positive safelights to a negative at a IIb control gamma of 0.60 to 0.70, as is ordinarily done for picture negative materials (Fig. 14). Composite release prints of sound and picture records can then be made on Eastman Fine Grain Release Positive Film, Type 7302.

If a single copy record is desired, as would be required in theatre television, a negative tube image may be photographed directly on to Eastman Fine Grain Release Positive Safety Film, Type 5302 (35mm.) or 7302 (16mm.) or similar types, developed to a gamma of 2.2 to 2.5 in a positive-type developer, as shown in Fig. 16, and printed to a density that will give the best picture quality when projected on to a motion-picture screen. The presence of a sound track on a positive picture of this type poses considerable problems because of the necessity of using direct positive sound-tracks.

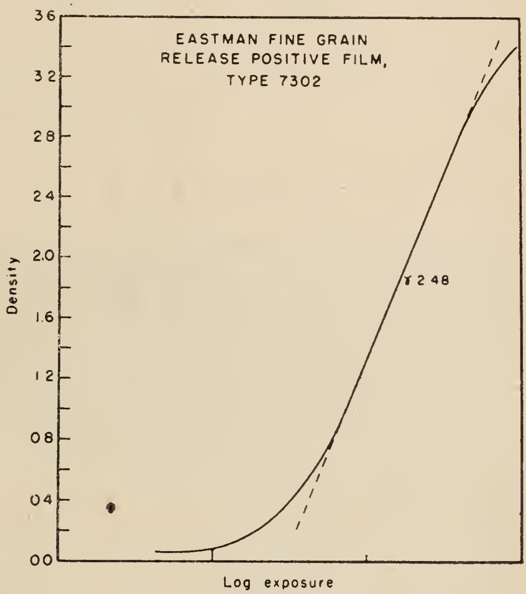


Fig. 16. Typical H and D Curve of Eastman Fine Grain Release Positive Film, Type 7302.

Non-linearity Correction.

It is most desirable in Kinescope recording to correct the non-linear characteristic of the Image Orthicon and the Kinescope being photographed. It will be assumed here that other circuits and components in a television chain are essentially linear compared with these two devices. There are two methods that have been used experimentally to compensate for this non-linearity. One is to build a correcting network in the form of a non-linear amplifier feeding the Kinescope. The amplifier would have the reverse characteristic of the apparatus to be corrected. This method has been tried, but the increased amplification causes considerable decrease in the signal-to-noise ratio.

Another method is to incorporate the correction in the emulsion, by having a special emulsion with an upturning shoulder or a section of reverse curvature between the straight-line portion and the regular shoulder of the curve. When enough correction is incorporated into the emulsion, correct exposure becomes very critical. When correct exposure is obtained on the negative and a projection print is made, the print density becomes so high that upon projection back on to the television system, the available illumination is reduced so that the signal-to-noise ratio is decreased beyond acceptability, and the shading of the picture, due to the Iconoscope characteristics, becomes intolerable.

Owing to the reciprocity-law failure of the emulsion, Eastman Fine Grain Sound Recording Safety Film, Type 5373, exhibits a considerable upturning shoulder characteristic, as shown in Fig. 15, when exposed by high-intensity radiation such as it receives from the rapidly moving, high intrinsic brightness of the Kinescope scanning spot. This emulsion shows no upturning shoulder characteristic when exposed by a low-intensity exposure such as the Eastman IIb Sensitometer.

Additive Losses.

When made on film, Kinescope recordings are subject not only to a reduction in the resolution and luminance range of the television system, but also to those of the photographic process ; yet they must be projected back on to the television system for reproduction, thus suffering additional losses. It is obvious that programmes recorded by this technique suffer considerable degradation in quality, yet they do serve a definite purpose in organizing television programmes and networks that cannot be accomplished without resorting to direct photography, which would require different lighting techniques and would frequently necessitate duplication of the programmes.

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A NEW STILL PROCESS PROJECTOR

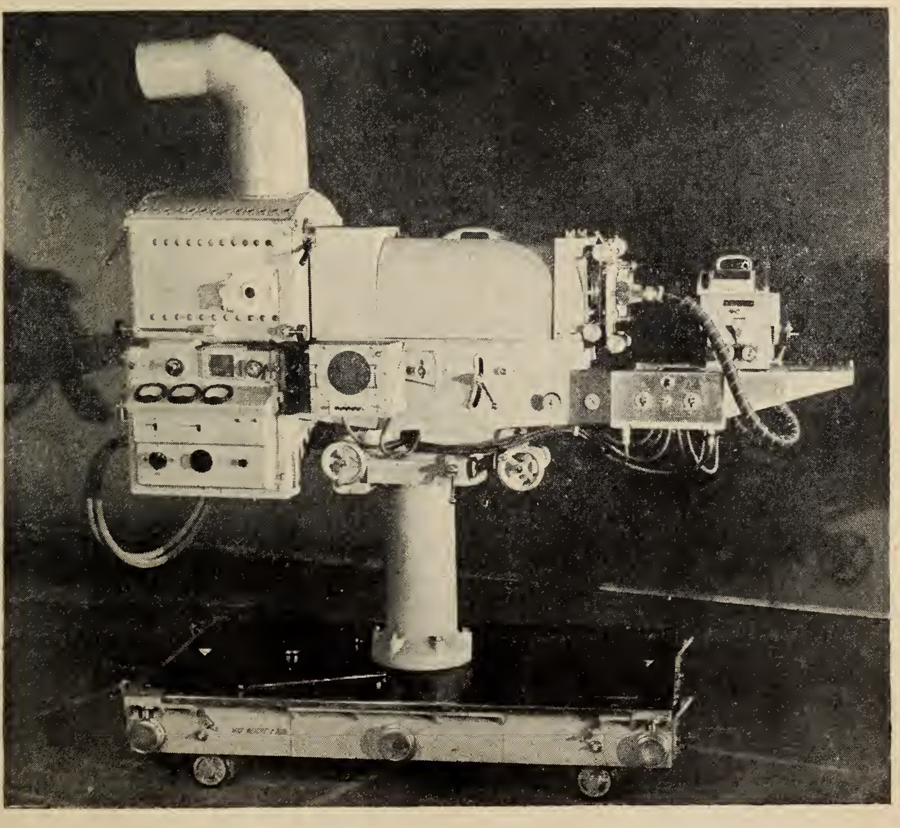
Hugh McG. Ross, M.A.*

THIS equipment for the projection of lantern slides for process work has been developed with two aims : to obtain an unsurpassed performance, and to meet the requirements of studio personnel, particularly with regard to convenience of operation and ease of maintenance. The basic studio requirements were marshalled by the Technical Director's Department of the J. Arthur Rank Organisation, and the main features of the design evolved. These were discussed by the senior process technicians within that organisation, by the manufacturers and by the scientific consultants, Sir Robert Watson-Watt and Partners ; detailed user-requirements were then prepared. The main manufacturers, British Acoustic Films, Ltd., kindly agreed to one of their senior designers working for some weeks at the studios, to interpret these requirements and to assimilate studio conditions. It is believed that the success of this projector is largely due to this close co-operation between studio technicians and the manufacturers.

Light Source.

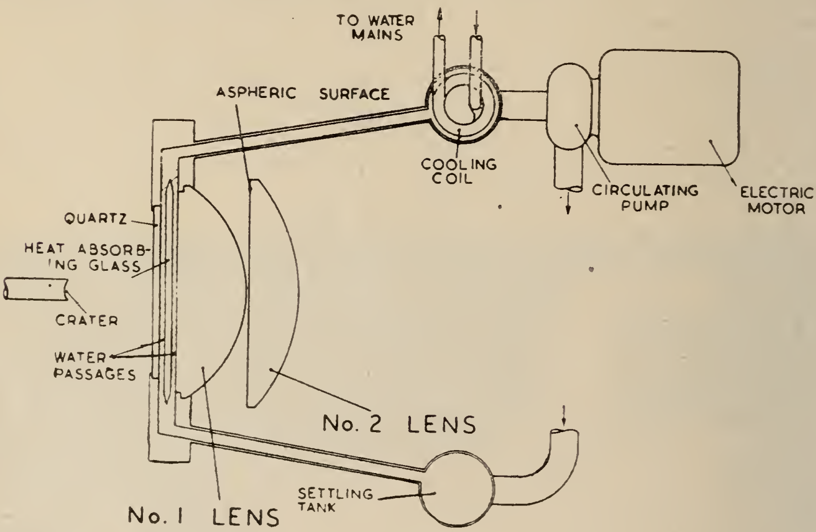
A Mole-Richardson MR 1250 arc lamp is used. This lamp has been described fully[1] and only the main features will be mentioned. The rotating positive carbon is 16mm. diameter and the negative is 11mm., non-copper-coated. Both positive and negative jaws are water-cooled. Four currents are

Fig. 1. Still Process Projector.



* Formerly J. Arthur Rank Productions, Ltd.

available, 150, 220, 260 and 300 amps. (the last corresponding to 20 Kw. in the arc), selected by a switch on the lamp which operates the contactors remotely. The striking and feeds of both positive and negative carbons are automatic. An optical device is fitted to maintain the positive crater at the correct distance from the first condenser lens, and its position never varies by more than ±1/32 inch. Trays are fitted beneath the lamp to hold new and used carbons. All the mechanical parts of the lamp are completely silent. The arc noise depends upon the current, but has never given trouble with the sound-recording when using this projector in an ordinary stage ; at 150 amps. nothing can be heard when standing at the projector ; at 220 amps. there is a slight deep rushing noise which is increased somewhat at 260 amps. At 300 amps. a slight secondary flame develops from the crater, which contributes some noise, but it is not loud enough to be audible at the microphone over the set. The steadiness of the light output is particularly good, being perfect on the 150, 220 and 260 amp. settings.



Condenser Optical System.

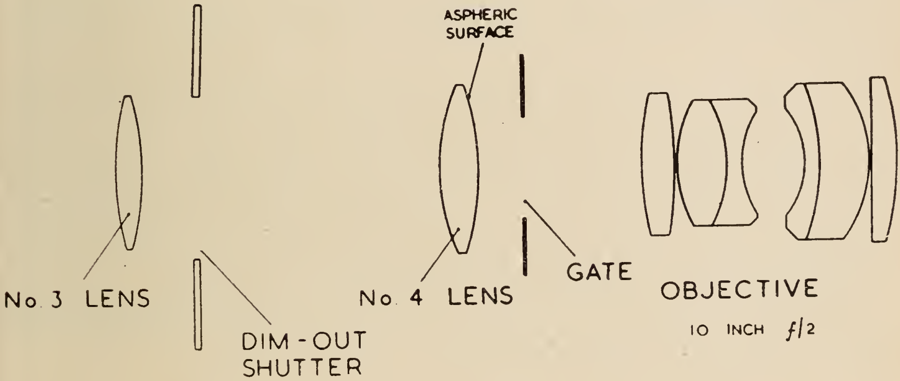
The relay condenser system (Fig. 2) has been designed by Mr. A. Warmisham and Mr. J. R. Scott, and made by Taylor, Taylor and Hobson, Ltd. The primary aim has been to obtain the greatest amount of light and yet maintain full illumination at the edges of the screen—in fact the edges are slightly brighter than the centre. The first lens, recently described in detail [2, 3], is only 2¼ ins. distant from the arc crater, its front surface being 5¼ ins. diameter. It is a compound lens, and also serves to filter out of the light beam almost all the unwanted infra-red radiation. The window nearest the arc is made of quartz and is cooled by a circulating current of water ; it never becomes too hot to hold one's hand against it. The water filters out some of the infra-red radiation, and the remainder is removed by a sheet of Chance Bros. type ON20 heat-absorbing glass. A further water passage assists in cooling this glass, and the light then passes into the lens. The heat taken up by the water is removed through a simple heat exchanger, cooled by tap water, which, after cooling also the arc jaws, runs to waste. Because the far infra-red has been filtered out, none of the lenses are heated unduly, and all can be made of crown optical glass.

Due to the efficient heat-filtering, the luminous efficiency of the radiation[2] reaching the slide is high, 190 lumens per watt (the figure for unfiltered arc light is 85 lumens per watt, and for white light perfectly filtered 220 lumens per watt). It is calculated that this combined heat-filter and lens absorbs only 10 per cent. more of the light than does an ordinary lens. This is, however, recovered, for it is unnecessary to use a spatter glass because the cool quartz window is not severely spattered by the arc, and is, in any case, not difficult to replace.

One face of the second lens is aspheric and this lens, together with No. 1 lens, images the crater into No. 3 lens.

The theoretical function of the relay condenser lenses is to provide sufficient variables in the design to fulfil all the required conditions—to accept the maximum amount of light, to fill the gate aperture and obtain the optimum distribution, and to fill the objective lens. In practice, the primary function of No. 3 lens is to throw on to the gate an image of a surface near No. 2 lens ; by moving No. 3 lens nearer the gate the light is spotted, *i.e.*, reduced in area and increased in brilliance, and moving it towards the arc floods the gate. No. 4 lens also has an aspheric surface, and its primary function is to converge

Fig. 2. Schematic diagram of the optical system, incorporating a combined heat-absorbing filter and water-cooled No. 1 lens, relay-condenser lenses, and an f/2 objective.



the beam of light so that it may pass through the objective lenses, which are of various focal lengths.

The mounting of each lens is designed so that it may be easily removed for cleaning and yet be dropped back in exactly the correct position.

Dim-Out Shutter.

Between Nos. 3 and 4 lenses a control is fitted for altering the brightness of the picture on the screen, comprising two curved blades of thick polished aluminium. It is, in effect, a two-bladed iris diaphragm. It is important that this shutter should not alter the distribution of the lighting over the screen while reducing its overall brightness, and its position is chosen so that it works equally well with all the objective lenses of different focal lengths, from 6.4 to 16 ins. It is possible to reduce the light on the screen by any amount down to one-eighth of the maximum without producing non-uniformity in the light over the screen of as much as ± 10 per cent. The light may also be dimmed right out. The shutter is not damaged in any way by the heat developed on it.

Objective Lenses.

The objective lenses were specially designed by Mr. A. Warmisham and his staff, and made for this type of projector by Taylor, Taylor and Hobson, Ltd.[3] ; they are believed to be unequalled in performance. The range available is given in Table I, and against each is noted the focal length of a camera lens which would give the same angle, or throw, (projector gate 3 x 2.2 ins.; 35 mm. camera sound aperture 22 x 16 mm.).

Each lens is a highly-corrected anastigmat, and all surfaces are " bloomed " to reduce reflection losses. When projecting rectangular line test charts it has not been possible to detect any distortion of the picture.

Quality of Image.

The flatness of field and resolution of these lenses has been measured in accordance with the British and American Standards methods. High-contrast Bureau of Standards line test charts were photographed so that there was a chart at the centre of the slide, and others at 5 per cent. of the distance to the centre inwards from the edges and corners, and this negative was projected. First, the best focus for the centre chart was obtained and the resolution observed visually. Secondly, the best overall focus was obtained and the centre resolution measured, and also the tangential and radial resolutions at the corners. The figures are recorded in Table 2, in terms of lines per mm. on the slide.

Consideration of these results shows that the definition is in all cases more than adequate. The best figure achieved with a normal motion picture camera is about 50 lines per mm. in the centre of the field, or on a 22 mm. frame the equivalent of about 1,100 lines in the picture width (in practice, of course, it is not as good as this because the definition falls off towards the edges of the picture).

The slide is 3 ins. across or 75 mm., so that the number of resolvable lines in the projected picture will be, in most instances, more than 2,000—or twice as many as the camera can resolve. This in turn means that one can " blow up " about one-quarter of the slide area to fill the camera gate without losing much definition, and since under normal conditions the camera is never focused sharply on the screen, the factor is even larger than these figures indicate. Under no normal operating conditions need one anticipate any falling-off in definition caused by this projector, when making process shots.

These tests were made with a slide 3 x 2.2 ins., but it was noted that with a slide 3 x 3 ins. there was no significant reduction in corner definition, except slightly in the case of the 6.4-in. lens.

TABLE 1—Focal Length of Lenses

Focal length, ins.	6.4	8	10	12.5	14	16	18	22
Aperture, *f*/	2	2	2	4.5	4.5	4.5	4.5	5.6
Equivalent camera lens, mm.	38	48	60	75	84	96	108	132

TABLE 2—Resolution

ins.	Lens	Best Centre Resolution	Best overall focus		
			Centre	Corners Tangential	Corners Radial
6.4	*f*/2 ...	56	28	28	40
8	*f*/2 ...	40	20	20	28
10	*f*/2 ...	40	28	28	28
12.5	*f*/4.5 ...	40	40	40	40
16	*f*/4.5 ...	40	40	40	40
22	*f*/5.6 ...	40	40	28	40

The holder for the objective lenses is provided with adjustments in three directions—focus, up and down, and cross movements—which may be operated manually at the projector or by remote control from a desk at the camera position. No noticeable distortion or degradation of the picture occurs on using these controls. The amount of vertical adjustment is ± 18 per cent. of the picture height, and the horizontal adjustment is ± 16 per cent. of the picture width. These movements are found to be of particular value for accurately positioning the picture on the screen in relation to the foreground set.

Method of Measuring Light Output.

Perhaps the most important quality in the practical performance of a projector is its light output. It is, however, inadequate to state merely the total light output ; for it is necessary to have fairly uniform distribution of light over the screen, and, what is even more important, the brightness at the edges and corners of the screen must be known. Due to the action of a back-projection screen, the edges and corners are the least bright parts of the picture, and the exposure at the camera is primarily determined by these areas. It is concluded, therefore, that the light output can be best defined by stating the distribution and also the total output.

It is not particularly easy to measure the light from a projector and obtain a figure which may be relied upon. To assess the distribution, it is found best to use a photo-electric photometer and make repeated measurements comparing rapidly the brightness of the required point on the screen with the centre. When averaged out, the result should be independent of the small fluctuations which arise, for example, from rotation of the positive carbon, variation in the carbons, or changes in the line voltage. To measure the total light output, a white surface of known reflectivity has been held at the centre of the screen, and the brightness of this measured with an accurately calibrated visual photometer (an S.E.I. photometer was used, after special calibration at the G.E.C. Research Laboratories, London). The average of a number of readings was taken. This brightness, in foot-lamberts, corrected for the reflectivity of the surface, was multiplied by the area illuminated on the screen (in square feet), and a correction added for the non-uniformity of illumination,

TABLE 3—LIGHT OUTPUT

Lens ins.	Light Output Lumens	Distribution
6.4 *f*/2 ...	52,000	Edges 8% down on centre. Corners 15% down on centre.
8 *f*/2 ...	55,000	Edges equal to centre. Corners 5% down on centre.
10 *f*/2 ...	55,000	Edges 10% up on centre. Corners equal to centre.
12.5 *f*/4.5 ...	49,000	Uniform.
16 *f*/4.5 ...	50,000	Edges 5% up on centre. Corners 5% down on centre.
22 *f*/5.6 ...	32,000	Edges 8% down on centre. Corners 15% down on centre.

to give the total output in lumens. The unit a lumen is essentially a measure of light as seen by the eye. Another method would be to use a photo-electric photometer fitted with a filter which gives accurate colour correction to visual sensitivity, but particular care must be taken to ensure its correct calibration to arc light (most photometers are calibrated to tungsten light, and a correction is applied for arc light, but this may easily lead to error). Only an approximate figure can be obtained by using a photo-electric instrument without a filter, for such meters are sensitive to ultra-violet radiation ; a considerable amount of such radiation is emitted by an arc[2] but much of it may be absorbed by glasses in the optical system, especially flint glass, and the amount on the screen may be very variable between projectors.

Available Light Output.

The distribution and output of this projector is affected by the position of No. 3 lens. Its normal position is chosen to give good uniformity, without significant fall-off in the corners, for the whole range of objective lenses. The light output, at 300 amps., and distribution through a 3 x 2.2 ins. gate is given in Table 3. At lower arc currents the light output is reduced proportionately.

These variations in distribution are so small that the screen appears to be

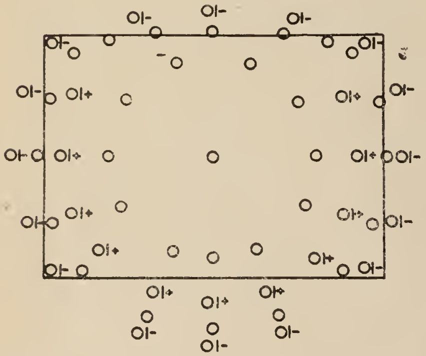


Fig. 3 Illumination of Slide having working area of 3 ins. by 2.2 ins.

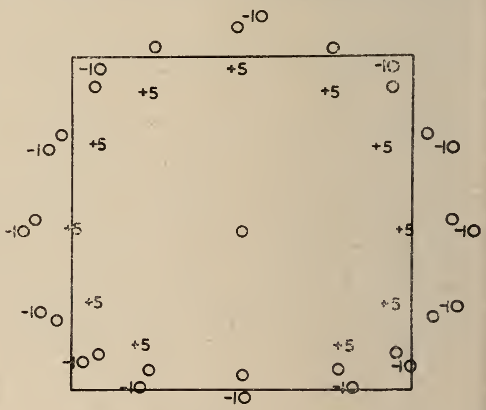


Fig. 4. Illumination of Slide having working area of 3 ins. by 3 ins.

very evenly illuminated. It is only a trained eye which can see the fall-off in the corners with the 6.4-in. lens, and this can be corrected by moving No. 3 lens a little. The reduced performance with the 22-in. lens is immaterial, because this is used only for small pictures.

As an example in practical terms, the light output shown in this Table is found to give good results on pictures 30 ft. x 22 ft., photographed at *f*/3.2 on Plus X stock, the subjects being daylight exteriors. If the area of the picture be reduced, the camera may be stopped down, *e.g.* 21 ft. x 15½ ft. at *f*/4.5, or 15 ft. x 11 ft. at *f*/6.3.

The effect of moving No. 3 lens has been investigated further. By " spotting " the gate until the fall-off in the corners just begins to be apparent, the distribution over the screen is as shown in Fig. 3, using the 10-in. objective. The rectangle represents the 3 x 2.2 ins. gate. At 300 amps. the total light output is 63,000 lumens.

When No. 3 lens is moved to " flood " the gate, the distribution of Fig. 4 is obtained, and in this case it is possible to illuminate satisfactorily the 3 x 3 ins. gate aperture shown. Although, of course, the brightness has been reduced, the increase in permissible area of gate results in a net increase in light output, giving 68,000 lumens at 300 amps.

By removing the aperture mask the total light output is nearly 90,000 lumens, but being an approximately circular patch of light, it is not of much value for process work.

It is believed that this equipment gives greater light output than other single-unit projectors,[4] particularly with regard to the brightness of the edges and corners of the picture.

Slide Holder.

The optical system is designed to fill a gate aperture 3 x 2.2 ins. This is the largest area of the standard 4 : 3 proportions which can be used on the usual British slide $3\frac{1}{4}$ x $3\frac{1}{4}$ ins., and, further, any larger size might require an inordinately large diameter for the No. 4 aspheric condenser lens.

The slide holder is designed to carry 5 x 4 ins. slides, and vertical, horizontal and tilting movements are provided so that a certain degree of animation may be introduced into the background, *e.g.*, for moving clouds, treadmill shots or

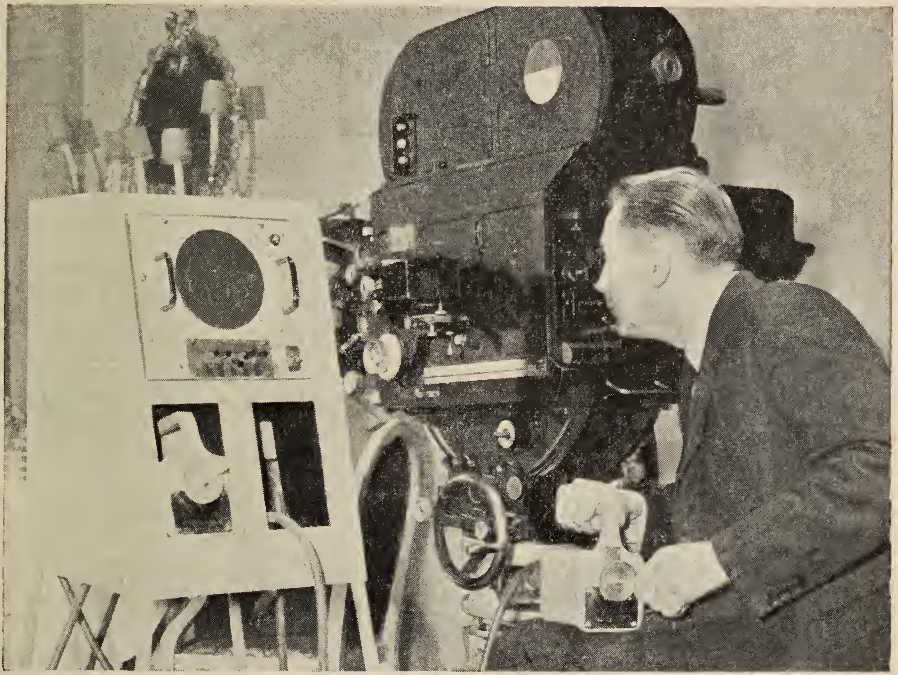


Fig. 5. Operating the Projector by Remote Control.

various trick effects. The total horizontal movement is 3.5 ins., the vertical 2.5 ins., and 30° of rotation. These movements may be made at the projector or by remote control from a desk at the camera position ; the mechanism is silent and may be operated during shooting. M-motors are used, working off D.C. to avoid hum. These motors rotate through discrete amounts, or " steps," and the gear-ratios between the motors and slide movements have been chosen so that it is not possible to see on the screen any jerkiness of motion. The two controls at the desk, shown in Fig. 5, can be drawn out on extension cables ; these can be switched at the projector on to the slide movements or the objective lens adjustments. A talk-back is fitted which gives good speech-tone and has ample sensitivity.

For shots where no movement is required, an adaptor may be used for carrying $3\frac{1}{4}$ x $3\frac{1}{4}$ ins. slides in the holder.

Slide Cooling.

The filter in No. 1 condenser lens removes half the heat from the lightbeam, but a considerable amount of heat is still developed in the dark parts of the picture by the absorption of the light, and the slide has to be cooled to prevent breakage. This slide cooler has been described recently [2, 3]. Glass windows are placed close to each side of the slide, and air is blown through the two thin channels so formed. At 300 amps., 50 cu. ft. per min. of air are used (measured at the outlet), giving an air velocity of about 340 m.p.h. across the slide, and heat is removed from the slide at the rate of 360 watts. At lower light levels less air is required. The temperature of the slide is kept down to a safe level, and it is normal practice to project for many hours slides of any density and made on ordinary glass. For Technicolor process projection satisfactory results are obtained using colour positives on cut-sheet film, cemented on to a glass slide for support.

The air is drawn from the studio compressed air supply, the system being shown in Fig. 6. A filter removes dust and water, the pressure is dropped in an ordinary control valve and a silencer removes the very loud hissing noise from the air. After passing through nozzles into and out of the slide holder, a second silencer removes all noise from the air before it exhausts into the studio.

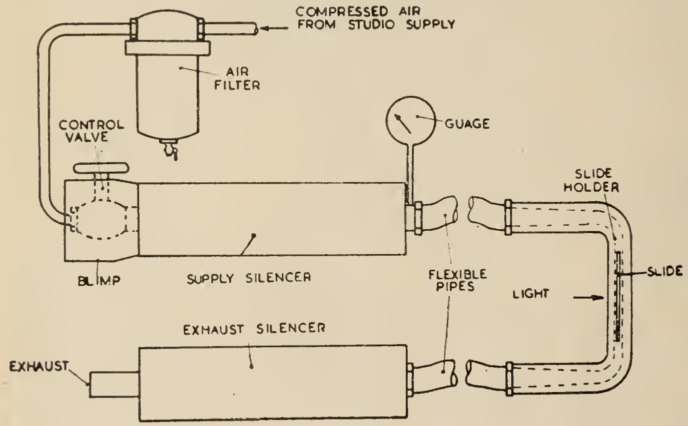


Fig. 6. Schematic diagram of slide-cooling equipment. Glass windows are placed close to each side of the slide, forming narrow channels through which passes air taken from the studio supply. Silencers remove the noise from the air.

The silencing of this cooling system has been given much attention. It is, relatively, extremely quiet, and what little noise it does make chiefly comes through the thick glass windows on either side of the slide. At the setting for 150 amps. there is a just-audible hissing sound at the projector. At 300 amps. this is quite noticeable at the projector, but no trouble has been experienced with the sound-recording at the set, and it is not necessary to place anything between the projector and set to reduce the noise.

Main Metalwork.

The aim in the design of the optical bed was to obtain a very strong structure on which the mounts of all the optical components would be very accurately positioned. Consequently, a single casting is used, and all the lens-locating surfaces were machined in one operation.

The main casting is supported from the central column through pan and tilt adjustments, the relevant dimensions being made as large as possible to ensure rigidity and freedom from backlash. There is no limit to the rotation in panning, and provision is made for tilting 15° upwards and 10° downwards. One turn of either control gives 1° of movement. Locks are provided directly between the main casting and the vertical column on each movement, which provide extreme rigidity ; they are designed so that the picture is not displaced as the lock is brought on.

No vertical adjustment is provided in the central column because it is our experience that precise positioning of the projector is unnecessary, particularly when using high-diffusion screens. This makes it possible to provide a really rigid lock to the pan movement, which is a very real advantage.

Projector Base.

The base of the projector is in the form of a platform on which the operator may stand. It is of heavy cruciform cast construction. The pairs of rubber-tyred wheels at each corner may be steered in pairs, or locked off, and four jacks are provided. The details of the base were worked out to permit the projector to be carried in elevating towers available at the studios, and consequently guide rollers are provided along each side, and the wheels are made retractable. Lugs are provided at each corner to permit the projector to be lifted by chain tackle in the studio roof, and the base is strong enough to withstand the effect of the weight being taken at only three of these lugs.

All the main metalwork and the base are of light-alloy, and were made by Turner Brothers, Ltd., Birmingham.

Location of Components.

One of the features adopted in the design of this projector, which is rather unusual in such equipment, is the extensive use of kinematic principles for the location and mounting of the optical components, the lens mounts being designed by Mr. T. W. Clifford, of Taylor, Taylor & Hobson, Ltd. Briefly, kinematic design recognises that any part can theoretically move in three directions (along the projector, across and vertically) and can also rotate about three corresponding axes. If the part is to be prevented from moving in any one direction, one restraint or clamp, and *only one*, must be provided ; and for each direction in which it is to move, only one control shall be provided. Examples are location by a ball fitting into a conical hole, a three-legged stool, or a typewriter carriage running on two balls in V-shaped guides.

These methods are usually harder to design than the more normal ones, but it is often easier in the finished machine to obtain the required accuracy of positioning when it is impractical to set up specialised machine-tools for construction. More important, perhaps, is that assembly is simple, and, therefore, maintenance is assisted because the components can be taken apart and easily put back in exactly the same position.

Mounting of Lenses.

Experience has shown that in an optical system of the type used here, it is necessary to keep all the lenses exactly on the optical axis ; if adjustments are provided it is difficult to know which one to alter to remedy any defect, and soon the system gets out of order. The only exceptions are the positions along the axis of No. 3 lens, and of the objective lens mount—to accommodate the range of focal lengths—and the position of the arc crater with respect to No. 1 lens.

All the lenses (in their circular mounts) drop on to locating surfaces on supports, and these are in turn located on the two machined surfaces seen in Fig. 7, running the whole length of the optical bed. The supports are constrained sideways and squared up, by being held against the vertical side of the centre rail visible in the figure ; the adjustable units are merely clamped against this, using the right-hand inclined side of the rail.

The problem of accurately mounting an *f*/2 objective lens weighing 33 lbs., so that it is adjustable in three directions (focus, cross and vertical) and yet may be moved by small remote-control motors without any backlash, has been solved by Mr. Clifford, using a kinematic design.

Securing Arc Lamp.

The arc lamp is secured to a large hinge along its rear edge by a single bolt in a slotted hole. A large screw under the front of the lamp tips it up and down to give vertical adjustment of the crater ; two screws at the sides of the front of the lamp swing it across for cross adjustment ; and for longitudinal adjustment the whole lamp is moved bodily. Although the lamp weighs 300 lbs. these adjustments are easily made and are readily locked off.

The three movements on the slide holder are based on the typewriter carriage principle ; the slide is held accurately square to the optical axis with the minimum of " wobble," and yet may be easily moved by the M-motors.

Controls and Adjustments.

All the controls of these adjustments (and the main tilt control) are fitted with stops which act when the end of the movement has been reached. These operate as near as possible to the hand-wheels, so that none of the internal mechanisms are accidentally damaged ; this reduces servicing troubles.

The direction of movement of the picture resulting from turning any control has been standardised according to the convention that clockwise rotation moves the picture to the right, or downwards. In the remote control desk the electrical connections to the cross-movements have been reversed, since the operator there is looking at the other side of the screen.

The controls are labelled and their direction of movement shown by arrows. They are all on one side of the machine, and all electric cables and other pipes couple into the other side with quick-release connectors. The electrical connections between various units are made with colour-coded plugs and sockets, so that no wires have to be undone to remove any part should trouble occur.

The minimum number of different sizes of bolts have been used to reduce the number of spanners needed for servicing. All screws have coin-slots for quick removal in emergency, particularly on covers to electrical gear.

Facilities for Double- and Triple-Head Work.

For very large shots or when extra brightness is required, two or three of these projectors may be placed side by side with identical slides in each. The total light output, and, therefore, the total area of the picture is accordingly doubled or trebled.

To ensure that exact overlap of the pictures is obtained, without any keystone distortion of the picture from the outer projectors, it is necessary that the slides in their holders are exactly parallel to each other, and then the cross-movements of the objective lenses are operated until the pictures merge.

Superimposing Screen Images.

Two methods are available for aligning the slides. Using the first, the projector is fitted with a spirit-level in a holder which may be inclined. The holders on the projectors are set at the same figure (in degrees) and the main tilt controls operated until the bubbles are in the centre of the glasses. For alignment in the other directions two V-notches are accurately mounted above the slide-holder ; spare carbons may be placed in these, and the pan controls turned until the carbons are sighted in line. After this, the main pan and tilt controls should not be altered, but the pictures merged by the adjustments on the lenses.

The second method is optical. Due to the wide range of movements available on the lens and slide, big errors could be introduced if they were in the wrong position. Accordingly, all these controls are first set to their centre, on-axis, positions, which are shown for each adjustment by an indicator and graduated scale. The two (or three) pictures are then thrown on the screen, and the main pan and tilt controls turned until they are on the same level but displaced about 4 feet apart sideways, this being the distance between the objective lenses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when the projectors are standing side by side. Then these main controls are left alone, and the pictures merged by the adjustments on the lenses.

Although complicated when described, this setting-up is simple in practice, and is greatly assisted by the remote control facility and talk-back from the desk at the camera. It is normal for two pictures to be perfectly merged within ten minutes of switching on the projectors, and triple-head work takes only a little longer.

The amount of cross-movement available on the objective lens is sufficient to give perfect correction from keystone effect on double-head pictures of 12½ ft. width, or over—this is irrespective of the focal length of the objective lens ; for triple-head work perfect correction is obtained on pictures 25 ft. wide or more. On rather smaller pictures the faulty definition introduced by keystoning could probably often be tolerated. The lenses have all been tested in the extreme offset condition ; the effect on the resolution and distribution of illumination is too small to be visible at the camera, except in the case of the 6.4 in. lens, and then the fall-off would probably not matter in most shots.

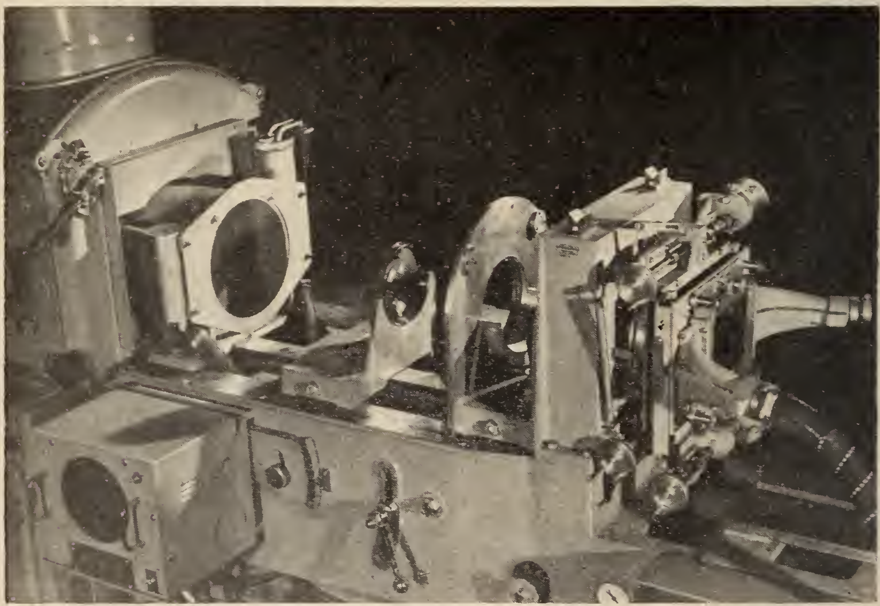

Fig. 7. Central part of optical bed, with cover removed. Left, water-cooled No. 1 lens projecting into lamphouse ; centre, one of the relay condenser lenses, and dim-out shutter ; right, slide holder with its adjustments.

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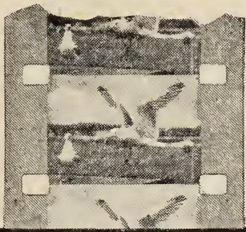
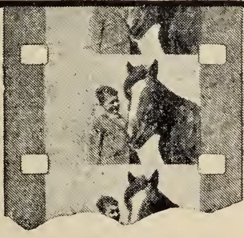
high speed



H P 3

Pan F



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THE COUNCIL

Summary of meeting held on Wednesday, October 4, 1950.

Present : Mr. L. Knopp (*Vice-President*) in the Chair, and Messrs. F. G. Gunn, B. Honri, R. E. Pulman, S. A. Stevens and R. J. T. Brown (*Rep. Papers Sub-Committee*).

In attendance: Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from the President and Messrs. W. M. Harcourt, H. S. Hind, T. W. Howard, N. Leevers, E. Oram and I. D. Wratten.

Council Meetings.—The Vice-President extended a warm welcome to Mr. R. J. T. Brown, Chairman of the Papers Sub-Committee. The work of the Sub-Committee was of such vital importance that the Chairman had been requested to attend Council meetings to make his report and to discuss matters relevant to this side of the work.

COMMITTEE REPORTS

Theatre Division.—Matters concerning the papers for the last half of the session had been considered. A tribute was paid both to Mr. F. H. Sheridan-Shaw and Mr. R. E. Pulman for the work they had done in connection with the enrolment of new members and the collection of overdue subscriptions.—*Report received and adopted.*

Sub-Standard Film Division.—The view had been expressed on a number of occasions that the present title of the Division was inappropriate because of the suggestion of inferiority. The recommendation was submitted for approval :

" That the title of the Division be changed to 16-mm. Film Division, because of its being a more precise description of the work that is done."

The 16-mm. Investigation Technical Sub-Committees had drafted a plan of operation and were commencing work. The 1950-51 Lecture Programme had been completed with the fixture arranged for January 10th, 1951—" Service Test Films," by Mr. M. V. Hoare.—*Report received and noted.*

Film Production Division.—No meeting had taken place. The first paper of the session, "Practical Applications of Magnetic Recording—Tape and Film," had been successful and the meeting well attended.—*Report received and adopted.*

Journal and Papers Committee.—It was hoped that the position regarding the delayed issues of the Journal would have been rectified by November. There had been

[*continued on p.* 174

PERSONAL ANNOUNCEMENT

SALES ENGINEER required, age under 35, in good health, unmarried, as assistant to operating manager of cinema equipment in India. Applications should include full details of qualifications and should be addressed to Box No. 70, The British Kinematograph Society, 117 Piccadilly, London, W.1.

some difficulties concerning publication of the paper, "Motion Picture Film for Television," by Dr. O. Sandvik and T. G. Veal, but these had been overcome and the paper would appear in the November issue.

Difficulties had arisen in finalising the Lecture Programme for the first half of the session, and it was considered important that each Division should have a reserve paper which, at short notice, could be used to replace any item on the programme.

In regard to a System of Classification for the Library, it was recommended that a Technical Sub-Committee be appointed with the following terms of reference :

> "To report whether it is desirable to have a System of Classification and, if the answer is in the affirmative, to submit proposals for the classification and an estimate of the cost of operating and maintaining the system."

—*Report received and noted.*

Education Committee.—The course of lectures on Lighting for Kinematography, taking place at Ealing Studios, had been made possible through the good offices of Sir Michael Balcon, Major R. P. Baker and Mr. B. Honri. The syllabus had been widely circulated and it was likely that the course would be well supported.—*Report received and adopted.*

Annual General Meeting.—Arising from the suggestions made that large screen television should come within the ambit of the Society, certain proposals had been made for the consideration of the Councils of the British Kinematograph Society and the Television Society. The proposals included a scheme for members of both the Societies to attend the meetings of the other on a reciprocal basis, a means of obtaining the Journals of both the Societies at a reduced rate and the formation of a Telekinema Group.

The Late Humphrey Jennings.—A Committee had been appointed under the Chairmanship of Denis Forman to arrange a Memorial Film Performance for the late Humphrey Jennings. Great sympathy was felt for the project and every possible assistance would be given.

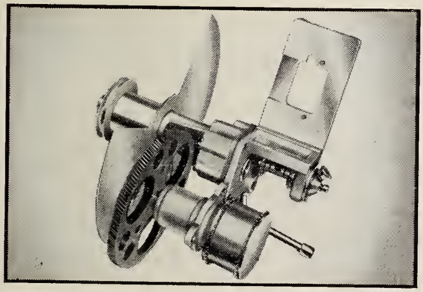
The proceedings then terminated.

Owing to pressure upon space, technical abstracts and other material are unavoidably held over.

NEW
portable equipment gives a bigger, brighter picture

combining many extra safety features

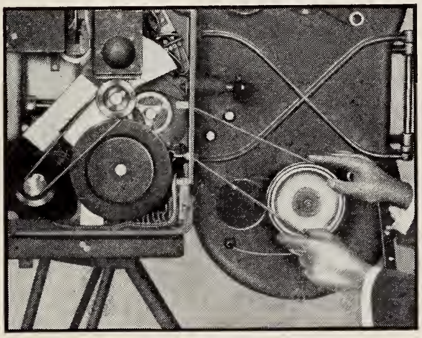
The equipment is attractively styled, and it can be easily erected within a few minutes. Two large milled screws secure the projector to the stand, and the twin spool box is fixed up in one manipulation.



Also mounted on the cam shaft is a small steel gear wheel which drives a large novotext gear wheel on the shaft of a 40-tooth sprocket. These are the only two gears in the mechanism.

BESIDES giving a brilliant picture measuring 13′ 2″ x 9′ 10″, Philips new portable 35mm. equipment also combines many extra safety features. In fact, these features make danger from fire almost negligible.

Sound reproduction of both voice and music is exceptionally clear and true-to-life. Another advantage of the equipment is its light weight ; this is because the projector casing is made of aluminium and the driving mechanism is greatly simplified.



Here you can see that the motor drives the cam shaft of the intermittent unit via a belt. A large flat shutter which is mounted on this shaft works at the same time as a fly-wheel for the intermittent unit.

Neither the projection lamp nor motor can operate if :—

- ★ **the projector doors are open**
- ★ **the film speed drops below 20 pict/sec.**
- ★ **the automatic film-rupture device comes into operation**
- ★ **the pad rollers have not been closed**
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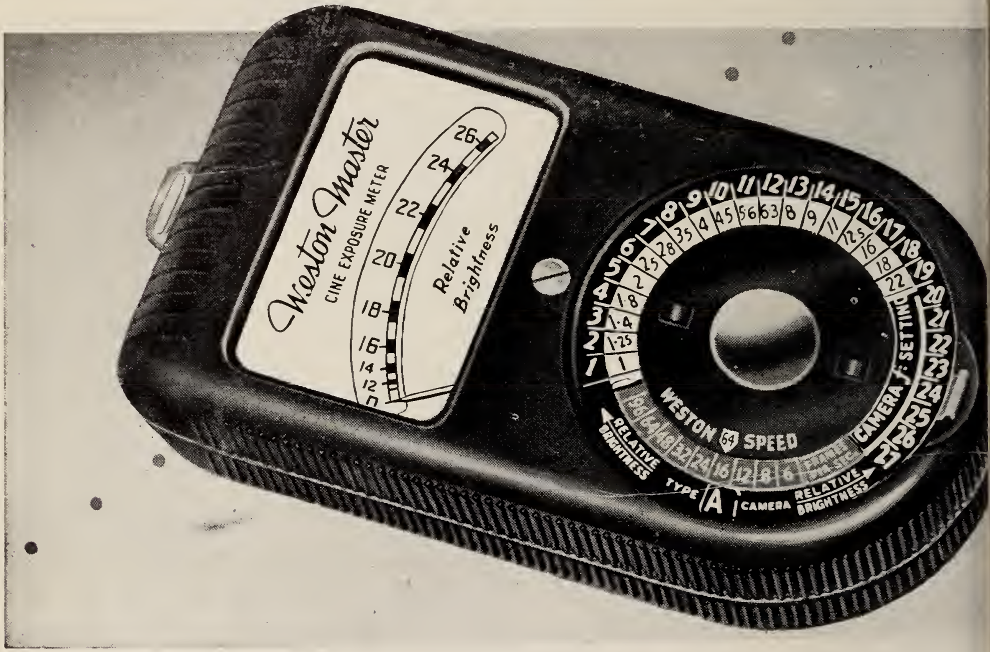

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BRITISH KINEMATOGRAPHY

The Journal of the British Kinematograph Society

VOLUME SEVENTEEN, No. 6 DECEMBER, 1950

LECTURE PROGRAMME — SPRING 1951

Meetings (except that of April 8) to be held at the Gaumont-British Theatre, Film House, Wardour Street, London, W.1, commencing at 7.15 p.m., Sunday 11 a.m. Meetings of the 16mm. Film Division in the G.B. Small Theatre.

SOCIETY MEETINGS

Jan. 10 **"Service Test Films"** (A demonstration of their use for picture and sound), by M. V. HOARE, B.Sc., F.I.B.P. (Joint Meeting with the British Sound Recording Association.)

Feb 7 **"The Film as used in Research,"** by R. McVITIE WESTON, M.A., F.R.P.S.

Feb. 14 **"Television Image Kinematography,"** by W. D. KEMP. (Joint Meeting with the Royal Photographic Society.)

March 7 **"How Should We Develop British Television?"** by IAN ORR-EWING, O.B.E., A.M.I.E.E., M.P. (Joint Meeting with the Television Society.)

April 4 **"The Evolution of Modern Motion Picture Film Stock,"** by GORDON CRAIG, O.B.E.

April 8 **Visit to the Festival of Britain Telekinema.**

May 5 **Annual General Meeting.**

THEATRE DIVISION

Feb. 11 **"B.K.S. Brains Trust."** Question Master: LESLIE KNOPP, Ph.D., M.Sc., M.I.N.A.

16mm. FILM DIVISION

March 14 **"Standardisation as a Means of Improving 16mm. Picture and Sound Quality,"** by WALTON T. RUDD.

FILM PRODUCTION DIVISION

Feb. 28 **"The Rational Application of Specialised Processes To Film Production,"** by T. W. HOWARD and A. JUNGE.

March 21 **"Time Saving Accessories for the Motion Picture Camera,"** by C. VINTEN and H. WAXMAN, B.S.C., F.R.P.S.

April 25 **"Gevacolor Products and Processes,"** by Ir. H. VERKINDEREN.

JOINT MEETINGS WITH THE A.C.T.

Jan. 17 **"Modern Trends in Art Direction,"** by M. J. MORAHAN.

March 28 **"Problems of the Producer,"** by P. C. SAMUEL.

April 18 **"Production and Laboratory Problems in Using 16mm. Negatives for 35mm. Prints,"** by D. CANTLAY.

PRACTICAL APPLICATIONS OF MAGNETIC RECORDING — TAPE AND FILM

A Symposium presented to a joint meeting of the British Kinematograph Society and the Association of Cinematograph and Allied Technicians on September 20, 1950.

I. HISTORICAL ASPECTS

K. G. Gould*

IN spite of the fact that magnetic recording has been an established method of quality recording for several years, and in spite of the fact that it is used very largely by the B.B.C. and many of the leading radio transmitting networks throughout the world, there has existed in the film production field a curious apathy towards this method of recording. It is right to consider what implications are contained in the possible, and very probable, extension of the use of this system as a means to achieving very necessary economies in the film production industry.

My own experience has shown me that what is being done to-day was treated with near derision by some British film technicians in 1947, and as no revolutionary change in the art has occurred within the last three years, it would seem that technical developments which might have been put to practical and economic use three years ago are still in the experimental stage.

It cannot be denied that serious problems, mainly relative to editing, are associated with this system, but it is also true that the technical advantages, economy of raw material, and flexibility of operation which the system offers, far outweigh the opposing factors.

Development of Magnetic Recording.

It is interesting to note that in sound recording we have completed a full circle, from the first patent on magnetic recording on iron wire of 1862, through the Edison phonograph, to the Poulsen Telegraphone wire recorder of 1900, the improved gramophone disc with the added advantage of the development of the thermionic valve, light cell recording on photographic film, the microgroove record, and now back to the starting point, at least in so far as fundamentals are concerned.

In the Stille Blattnerphone, a steel tape was used ; its drawbacks could be summed up in two terms, magnetic reluctance and self-demagnetisation.

One stage of development appears to have arisen out of the investigations of two Japanese engineers, Kato and Takei. They published a paper[1] in 1933 on a permanent magnet material prepared by mixing metallic oxide powders.

It may be suggested that the German development of magnetic tape recording, using a plastic tape coated with ferrous oxide powder, resulted from a study of the investigations of metallurgists who had carried out studies similar to those of the two Japanese referred to. In any case, in the years immediately preceding the last war the German Magnetophone appeared. Technically it was no great improvement on the Blattnerphone. Practically it had the advantage of a truly flexible, easily cut and joined magnetic carrier, which, by virtue of its light weight, considerably simplified the mechanics of the recording equipment.

The war closed down our knowledge of developments in Germany, and it was only when the research teams went into that country that the greatest step in the development chain was appreciated.[2] This concerned the discovery of the advantages associated with the use of supersonic currents for erasing and biasing, or pre-magnetising, a result of the work of two engineers in the German broadcasting organisation.

* Phidelity Magnetic Productions, Ltd.

Capabilities of Magnetic Sound.

It is possible to-day to obtain results with magnetic recording which compare most favourably with any other system of recording, including optical. For example, at 35 mm. film speed the frequency response can be kept level between 50 and 10,000 c/s. ; at 16 mm. film speed between 100 and 5,000 c/s., and the 8 mm. film can achieve something in the region of a top response of 3,000 c/s.[3]

One great advantage of magnetic recording, as compared to optical recording, is a much higher signal-to-noise ratio. Scratches, dirt and dust have no appreciable effect upon magnetic reproduction. An accepted figure of volume range on noiseless optical recording is 50 db. The magnetic recording field claims up to 60 db. and some systems as high as 70 db., given a good magnetic coating, used in conjunction with good magnet designs, and good circuiting.

The great disadvantage of the system as it concerns the film technician is that the magnetic recording is not visible. It can, of course, be made visible by the simple expedient of allowing metal dust to adhere to the magnetic striations,[4] or the track can be reproduced on a cathode-ray tube, but no method exists to my knowledge which gives an editor the same facility of reading the track as he can with an optical recording.

Design Requirements.

The various links in the chain of a magnetic recording system are the wire, tape or coated film, the electro-magnet, the mechanism which feeds the wire, tape or film across the magnet pole pieces, and the amplifier system. Time need not be spent in much consideration of the mechanical aspect. Obviously the design must be similar to that used in optical recording, in that the magnetic carrier must be pulled across the flux gap of the magnet at a constant speed, its movement free from flutter.

The amplifier design differs somewhat from optical recording systems in that severe frequency correction, depending upon the type of magnetic coating, is necessary. In playback it is necessary to consider that the voltage output of the magnet increases with frequency, which calls for further correction. Nevertheless, there is nothing in the design of recording or playback amplifiers which the electronic engineer cannot take in his stride. The electronic circuit used for recording must also include an oscillator, which provides a current at a frequency well above the audible range, for bias and erasing.

Other than in the film industry, the carrier takes the form of a ¼-inch wide plastic tape, such as is used on the machine which has been used to reproduce the earlier part of my talk. A plastic tape is not very suitable for synchronous sound recording, by virtue of the fact that it is pulled through the mechanism by means of a pinch capstan drive ; a smear of grease will create variable slip. Stretching of the tape is also an ever-present risk. It is, therefore, more practicable to use a sprocket-holed carrier where perfect synchronism is required, and magnetic powders can be coated on to any film base. Existing arrangements entail the use of a 35 mm. base on which several magnetic tracks can be recorded.

Some development has been attempted whereby the ¼-inch tape can be kept in synchronism in spite of slip and stretch,[5] but these resemble generally the same methods used in the past to keep a gramophone record in synchronism. As 35-mm. is the professional standard, it would appear to be wise to concentrate on a 35-mm. carrier for magnetic coating.

Sound for the Non-Professional.

Before the development of magnetic tape, the average layman had no simple means of recording sound. He could, of course, have purchased a fairly expensive gramophone disc-cutting equipment, but few people had the ability to use it. The machine that has been heard to-night can be bought at a reasonable price, and little skill is needed to make sound recordings of fair quality on it. Other machines are on the market which can be coupled to sub-standard projectors[6], enabling a commentary with music and effects to be played in near synchronism with a silent film. If such a machine can run a tape a very similar machine can run a perforated coated film, and so perfect synchronisation can be obtained.

Let us turn for a moment from the amateur to the semi-professional. Most big organisations have their own film production units nowadays. Prior to the advent of magnetic recording most of them were restricted to silent films. Some, however, spent money on optical recording. They are now using magnetic recording to an ever-increasing degree.

When they are able to obtain film stock with a magnetic coating on its edge, the growth of amateur and semi-professional sub-standard film recording is bound to be very rapid. That situation will certainly arise, and I have already seen some fair efforts of such film coating which have been achieved by amateur film clubs in different parts of the country.

The 16-mm. film has grown during the war and post-war years from an amateur to near professional status. On the Continent, at least in France and Italy, there are more 16 mm. kinemas than 35 mm., and a 16 mm. magnetic sound film projected on a properly designed machine with arc lighting may in future compete with the professional 35 mm. industry. Another consideration is the extended use of 16 mm. " blown up " to 35 mm., particularly if one considers the possibility of recording sound on a magnetic track within the camera itself, and this also opens up a possible answer to the editing problems, for if the sound is recorded on the edge of the film, in the camera, there is no necessity to see the sound track, which remains an integral part of the picture.

Considerations for the Recordist.

You must excuse me for that brief peep into the possible future. In considering the application of magnetic recording to the motion picture industry, I would suggest that the practical approach is best summed up in the following suggestions :

First, we must rid our minds of the idea that difficulties associated with the use of this system cannot be surmounted.

Secondly, it behoves every technician to acquire as much knowledge of this system as possible.

Thirdly, the professional should always be at least one step ahead of the amateur; at the moment the reverse is sometimes the case.

Finally we must rid our minds of the idea that professional magnetic recording means an equipment which can be stowed in a suitcase and operated by unskilled labour. It is a system which calls for the same care and skill in operation as optical recording if the same quality is to be maintained.

Superlative quality must always remain the yardstick by which the feature film production field is judged. It would indeed be a grave mistake for anyone to imagine that the use of magnetic recording can bring economies in the shape of fewer operatives or less skilled technicians. The microphones, the mixing panels, the recorder itself will still require the expert manipulative touch. The maintenance must still go on.

Its use can, however, bring about very considerable economy in film production in the shape of great saving of raw stock and time, and greater flexibility through its facility of immediate play-back.

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4. *Brit. Kine.*, **15**, No. 2, Aug. 1949, p. 37.
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II. USES IN FEATURE FILM PRODUCTION

W. S. Dalby, M.B.K.S.*

IN feature film production, the expenditure of film recording stock and the mounting processing costs necessary to produce a good take of a script scene, have until recently been regarded as an inevitable part of the high cost of production, but now that synchronous magnetic recording systems have been produced this is no longer the case.

Magnetic recording is by no means an entirely new development. In 1932, at the studios of British International Pictures, some experiments were made with a magnetic recording system, the Blattnerphone, in the endeavour to use it for sound film recording. The main problem was to hold the tape in synchronism with the picture camera, and because of this difficulty very little use was made of magnetic systems at that time.

Editing and Transfer.

The magnetic sound film can now be handled in the cutting room as easily as the normal photographic sound film, provided an editing machine fitted with a magnetic reproducer head is available. It is, however, my opinion that for feature film production, bearing in mind the length of time that a film is in the cutting room and the consequent risks of physical damage to the film base, it would be unwise to use the original magnetic recording as the cutting copy positive. It must be remembered that this is also the sound negative. In view of this, we at Ealing, when using magnetic recording, have always transferred the chosen take on to our normal photographic sound track. The actual operation of transfer is of course almost automatic, the record being played off from the magnetic recorder into a normal film channel without variation of level or change of characteristic.

This routine having been laid down, it was decided to use a magnetic film recording system on a production entitled—appropriately enough—" The Magnet." This picture commenced shooting with six weeks' exteriors at New Brighton, and a temporary studio was fixed up in a disused hall there to enable small interiors to be shot in case of bad weather. When shooting started, the rushes were sent daily to the studio at Ealing, and the take corresponding to the printed take of the picture was transferred to film. Many of the exterior recordings were used as guide tracks for eventual post-synchronising, as would have been the case if photographic recording had been used, but the original interior tracks were incorporated in the completed film. In addition to these a number of dialogue " wild " tracks of the local artistes were made to cover some of the exterior shots, and a large footage of sound effects was shot for use when the picture was re-recorded.

The economy effected on this short location was considerable ; of course, the actual amount saved will vary considerably according to local conditions. The higher the number of takes of any scene, the greater the economy when only one or two are printed, *i.e.*, transferred to film.

Choice of Equipment.

The equipment used for the " Magnet " location was a G.B.-Kalee " Ferrosonic " studio type channel mounted in a recording truck.[7] This of course can be used only where transport can reach, and it was apparent that a more portable type of channel would also be required for certain locations. Tests have recently been carried out with a very portable magnetic recorder developed by Messrs. Leevers, Rich, which uses tape, not perforated film.[5] This is powered from a 12-volt accumulator, and will give a synchronous record, as the playback speed is controlled by a pulse recorded on the tape. The

* Ealing Studios, Ltd.

recorder and picture camera are driven independently, but the synchronising impulse is provided by a simple attachment which can easily be fitted to the mute camera.

This equipment will be used in Africa on our picture "No Vultures Fly," both for reasons of economy when recording sound effects, wild animal noises, etc., and by reason of its extreme portability on other shots where the use of a recording truck is not possible. Selected portions of these tape recordings will be transferred to photographic film on location and sent to England as rushes in the normal way.

Production Economies.

There are other ways in which considerable economies can be effected in film production by using magnetic recording.

Post-synchronising.—If the recording machine be interlocked with a picture projector the facility of immediate playbacks would enable the result to be checked while the artiste was on call. This would frequently economise on artistes' salaries, in addition to the very great saving in film stock and laboratory costs. Probably 75 per cent. of the cost of post-synchronising could be saved if magnetic recording were used.

Re-recording (Dubbing).—It is the practice in most studios to-day to run at least two film recording channels in parallel on dubbing sessions, in order to produce at least two original sound negatives. We at Ealing use these negatives, one for home release and one for U.S.A. release. This practice ensures the best sound quality for American release, but is very wasteful in film stock.

If other negatives are required these are usually, though not always, made by recording a straight transfer from a (positive) print from the original negative. Although this gives a better result than the photographic dupe method, a certain loss of quality results.

It is possible that all these sound negatives could be produced by transfer from a magnetic recording. This would mean that instead of two film channels being used, one would use a film recorder and a magnetic recorder in parallel for a dubbing session.

Scope of Magnetic Recording.

It may be wondered why it is necessary to record anything except release negatives on film. The time may come when magnetic recording will be used for all the production processes ; it has been stated that on some pictures in America it is being so used.

We at Ealing have only been able to give a limited trial to this newest recording medium, but with more experience of it its possibilities will be more and more apparent. At the moment, it would appear that magnetic recording is a useful tool in the modern film studio, but in offering additional facilities rather than replacing photographic recording.

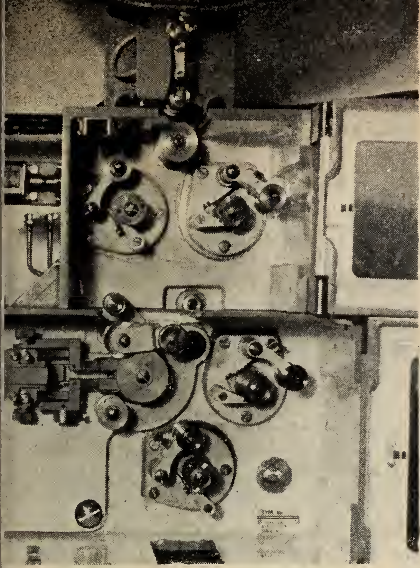
III. USES IN DOCUMENTARY FILM PRODUCTION

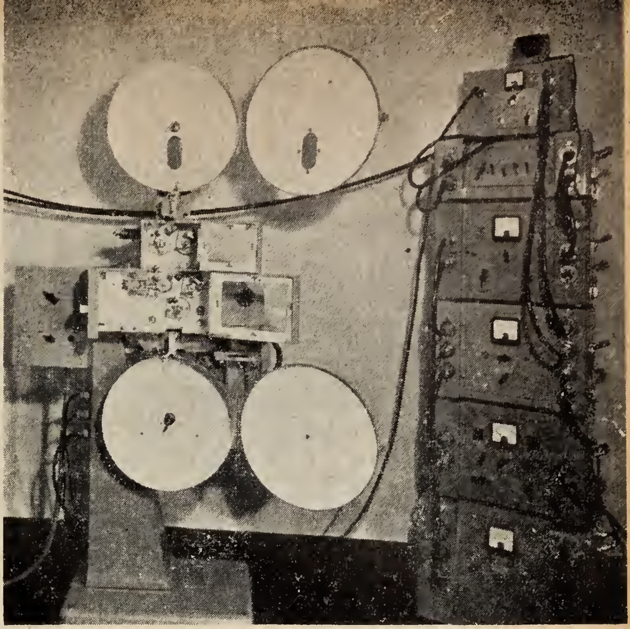
P. Birch*

HAVING spent many years working on both feature and documentary recording, I have decided that basically there is little difference between their purely technical requirements. The resources of the sound engineer to a documentary production unit are, however, generally on a smaller scale, as there is less money to spend and fewer staff available. It can be appreciated that anything calculated to reduce these handicaps is enthusiastically welcomed.

A year last October my company was offered a British Acoustic magnetic recorder, and it has been in constant use ever since, without any regrets.

* British Instructional Films, Ltd.





" Ferrosonic" Magnetic Recording Equipment as used at Ealing and British Instructional Studios,

Objects of Use.

Our organisation is not very large, but last year over a million feet of sound track was used at a cost of £11,000. With that, 150 reels of finished film were produced, including a number of children's films, which are features in every respect except their distribution. Although the ratio of film stock expenditure is usually lower than in feature production, our company hoped that magnetic recording would enable them to reduce the £11,000 by at least half. Exact costs will not be available until the end of the present financial year, but figures to date are very favourable.

An example of saving is as follows : Two reel short, with commentary and background music : saving in raw stock for commentary, £15 ; transferred to photographic film without rush print, a saving of £10 10s.—total saving of £25 10s. If music recording and dubbing had been necessitated, the saving would of course have been appreciably greater.

The sound engineer uses the magnetic recorder for the following purposes : commentaries ; music ; post-synchronising voice and effects of every kind. Only those takes passed by the director and producer are transferred to film.

Dubbing can be carried out on the magnetic recorder. Several tracks may be pre-recorded on magnetic, and a final track obtained by mixing this pre-recording with the remaining tracks to be embodied. In effect, it enables a larger number of tracks to be mixed without processing delay.

Methods of Operation.

The cost of transferring is regarded in some quarters as offsetting the saving otherwise gained. This is far from the case. Transferring is done easily and quickly behind the scenes. A staff of three is needed to do it, but it does not take very long. In transferring, much depends on an efficient lay-out of the two channels for easy and rapid working, also a good reference system. The magnetic and photographic channels and darkroom in our company are adjacent.

It has been previously mentioned that fewer staff are allowed in documentary firms. That precludes much time being spent in making tests and maintaining equipment. Therefore the equipment used needs to be robust and not too temperamental. The first magnetic heads we used caused some trouble ; they have now been modified to internal scanning, and have since been free of trouble.

The equipment used in our company is tested once a week, but apart from slight wear on the faces of the heads, the setting up has not had to be altered to any great extent. Some stock gives a little trouble by "ghosting," caused by a strong image setting up a magnetic shadow of itself on adjacent layers of film, but the majority of stock is free from this. "Wow" appears to be non-existent, although it can happen with poorly maintained gear, and re-setting up can usually cure imperfect wiping.

Editing Difficulties.

Joining and the varying sensitivity of stock have been major difficulties. Both of these are capable of remedy, but at present it is advisable to try to keep the rolls of magnetic film intact.

Tests have shown that the hiatus caused by the passage of a join past the recording head is sometimes unnoticeable, but generally can be detected where it coincides with modulation. An occasional join could be tolerated, but at this stage it is difficult to say whether it would be practicable to use a roll with many joins. Future recordings on the same roll have to be borne in mind.

The problems associated with joining will be explored more thoroughly when some enterprising studio adopts magnetic recording for all stages, except the final transfer of the track to photographic film. Editing of tracks and their laying for dubbing will bring to light the best way of handling the problem of joins, in the same way as blooping was developed in photographic sound.

There is much to be said both for and against using magnetic recording for all stages. I foresee many complications. When it does happen the consumption of magnetic stock will increase enormously. In my own case, my stock of magnetic film is not consumed to any extent. Extensive editing can be left to a later stage of development, or, at any rate, until the need is more pressing than at the present time.

The most difficult task at the moment is to convince producers that it is impossible to give them quality equal to magnetic recording on photographic film. Surface noise is negligible on the former and gives the impression of cleaner sound.

A demonstration reel, consisting of piano, speech and orchestral recordings, transferred on to photographic film, was reproduced.

DISCUSSION

Mr. Bretton Byrd: In view of the wide volume range of magnetic recording, is it still necessary to use compression?

Mr. Birch: Although the amplifier has a compressor incorporated, I have not found t necessary. The line of demarcation of over-shooting is not so clearly defined as in the photographic equivalent.

Mr. Dalby: I find compression is an invaluable aid to overcoming the poor diction of some artistes.

A Visitor: Is it possible to go on location with a small camera and synchronise it with your magnetic drive?

Mr. Dalby: I understand that the synchronising method will work with any camera at any speed, provided it is fitted with a pulse wheel—a serrated wheel passing over a pole-piece giving a pulse which is recorded on the tape. The camera can even be driven by clockwork.

Mr. Gibson: What is the objection to using two recording heads? Instead of cutting, we transferred from the original tape to a second tape. The film was run through until we got to the point we wanted, and then recorded that part on the final reel.

Mr. W. S. Bland: An American studio uses nothing but the magnetic medium until the final dubbing for release. They took all their tracks, re-recorded them on to photographic direct positives, which were used for cutting. All tracks, both photographic and magnetic, were edge-numbered to correspond with the picture. Having cut the photographic record, they line up those tracks with the original magnetic tracks, and re-record those sections of magnetic on to rolls of films for the dubbing track. They finish up with a lot of rolls of magnetic film, with the original records put into their appropriate places for cueing. It seems a very laborious process.

Mr. K. Gordon: How do they transfer the edge numbering from the photographic film to the magnetic tape?

Mr. Bland: It is printed on. I do not know what they do when they want to use the same tape for another film.

Mr. K. Gordon: Surely in transferring to film, the original superior characteristics of magnetic recording are lost?

Mr. Birch: That is perfectly correct. But if the original recording is on film, you have two lots of loss.

PRECISION METHODS IN PRODUCING 16mm. COLOUR FILMS

Denis Ward, Ph.D., M.B.K.S., F.R.P.S.*

Read to the B.K.S. Sub-standard Film Division on November 8, 1950.

IT is proposed to confine this talk mainly to production of films in 16 mm. Kodachrome. This is done for two reasons : first because I have had more practical experience of this medium than other colour processes, and secondly because 16 mm. Kodachrome is one of the few processes which can be used for direct 16 mm. production in this country.

The target to be arrived at in producing a 16 mm. colour film must be the results in projection : for the picture, a bright picture of high definition ; for the sound, quality, with particular reference to intelligibility under average 16 mm. projection conditions. Let us consider these.

Colour Photography.

It is not proposed to discuss picture definition except to say that fully corrected lenses and good equipment are required, and that contributory factors to apparent good definition are depth of focus and careful lighting.

Neither is it felt necessary to go into the theory of colour photography ; this has been dealt with fully many times before by those more competent to do so than myself. It is sufficient to mention that Kodachrome is a subtractive colour process, and consists of an integral tripack film made up of a base with three emulsion layers. The top layer is sensitive to blue light, the middle layer is sensitive to blue and green light, and the bottom layer is sensitive to blue and red light ; a yellow filter coating beneath the top layer prevents any blue light reaching the other layers, so that the result is that the layers working from the top are sensitive to blue, green and red light respectively.[1,2].

After exposure in the camera, the film is reversal processed. In the course of the processing, dyestuffs are developed in the layers, the silver removed, and the result is a colour positive comprising the base and three dyestuff images, one in each layer, complementary in colour to the colour which the layer recorded, that is working from the top, yellow, magenta and cyan.

The same fundamental principle is true for other integral tri-pack reversal colour films, such as Agfa[1] and Ansco Colour,[1,3] though the methods of developing the dyestuffs differ, whilst for negative-positive colour processes, again, the same principles apply, except that the colour positive is obtained by printing.

Colour photography makes use of the fact that if the visible spectrum be divided into three approximately equal parts, the radiations in each third will give rise to the sensations of red, green and blue respectively. There are unfortunately no dyestuffs yet known of which the spectral transmission curves are perfect for three-colour reproduction. Therefore accurate colour reproduction cannot be expected. The best that can be hoped for is a compromise and an approximation to truth in the picture.

Printing Limitations.

A further degradation inevitably occurs in making prints.[4] The spectral characteristics of the printing light are rarely the same as those of the light illuminating the original scene, also in any photographic copying process contrast is increased ; attempts to combat this tend to result in loss of colour saturation in the print.

In professional film production we are, of course, concerned with print quality. The master original film must be regarded and treated in the same

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way as a negative. The things that are used and seen, and on which the films are judged, are the prints. It is, therefore, of great importance to discover the characteristics required in the original in order to get the best prints.

In printing a reversal duplicate from a master original Kodachrome film, two things occur : the contrast is increased, and at the same time the colour saturation is decreased. We must therefore aim in the original at less contrast and more colour saturation than is wanted in the print. This means in practical terms that the contrast range must be carefully controlled *within* the limits of toleration of the film. The full contrast range of the film must not be made use of as if only the original were being produced.

Contrast Range.

It has been stated that the contrast range of illumination as between shadows and highlights for Kodachrome should not exceed 4 : 1. My own experience is that this ratio can safely be exceeded, and be as high as 5 : 1 or even 6 : 1, where originals only are required. For successful printing, however, the ratio of 4 : 1 should not normally be exceeded, and in certain cases should not exceed 3 : 1. Let one point be made clear, however ; a normal picture is being discussed where it is desired to see detail in both shadow and highlight. There are occasions where, for dramatic or other reasons, this recommendation can, and sometimes should, be ignored. Further, it is necessary not to confuse contrast range with brightness range, which owing to light absorption by certain coloured objects in the scene may be considerably greater than the contrast range.

Secondly, to obtain an acceptable print, it must be ensured that the original has enough colour in it. Fortunately, this is quite easily done by slight under-exposure, and my own recommendation is that one should under-expose by about a half stop compared with what would be done were a first-class original desired, though again this is a matter of opinion. It all depends on what result is being aimed at ; whether a " high key " result (or as high a key as one can get in 16mm. colour) or " low key," and whether the subject is light in character or dark.

Assessing Exposure.

In this country 16 mm. Kodachrome film is marketed in two grades— Regular, which is intended primarily for use in daylight (5900°K-6300°K. a mixture of clear sun and skylight) and Type " A," which is designed primarily for use with Photoflood lamps (approx. 3350°K) ; the appropriate grade according to what is to be undertaken will naturally be selected.

Before discussing light sources and their attendant difficulties, I would like to say a little more about exposure.[5] It is usual to use some form of photo-electric meter, though for daylight, the Kodak tables supplied with the film are remarkably useful and should not be despised. After some trials, I have come to the conclusion that a highlight method, measuring the light falling on a standard card, gives the most satisfactory results. There is no need to use a white card ; a neutral shade is, in my opinion, better, and this need not even be the same on every job, since one will always wish to carry out tests on each emulsion of film used. One of my colleagues obtains best results by using the S.E.I. meter, in conjunction with a white card, since this enables the contrast range between highlight and shadow to be measured more easily. Others use a Weston meter with equal success. Some have developed the knack of measuring high-lights only and judging the shadows by eye. When this is done a monochromatic viewing filter is a useful accessory. Whatever is done, if one is doing this sort of thing daily it is rare to make a mistake in exposure.

Test Films.

The making of tests before embarking on a job has been referred to. It is common practice with many to carry out tests with black-and-white emulsions ;

it is even more desirable to do this with Kodachrome. It is unfortunately true that the speed rating of Kodachrome varies slightly from batch to batch and Kodachrome has very little latitude. Neither is the colour balance of every batch of film completely constant. For precision results, therefore, the need for tests before any new batch of film is used in production is obvious. Because of these factors, it is not desirable to change batches in mid-production, though this may sometimes be inevitable due to circumstances beyond control.

Such tests can be carried out on a group of standard objects, such as a group of coloured bricks, well-known branded goods, a colour chart, and rounded objects, as well as black and white objects, but should also include one or more general scenes as nearly as possible in character to those intended in the film. The tests enable an estimate of the speed rating of the batch to be made in relation to the exposure-meter and high-light or other method used, and also a check to be made of the colour characteristics. They will naturally cover a range of exposures on the basis of which the general basic exposure to be used in the film will be decided.

In processing the test film the laboratory will be informed that it is a test in order that it may be processed under optimum conditions, so that the effect of day-to-day variations may be avoided, or at least minimised. Nevertheless, day-to-day variations in processing do occur, so that even after establishing the basic exposure in actual shooting in production, bracket exposures should be made to minimise the effect of such variations. It may in exceptional cases even be necessary to change an opinion made of the basic exposure as a result of examination of a run of film from production, though this does not often happen.

This leads to the question as to how the film from production should be processed. Certainly not in individual rolls. To wait until the entire picture is shot, however, is too extreme and the answer would seem to be to have it processed in sequences. Making bracketing exposures may seem to be an expensive method of working, but in my experience it is an insurance investment which pays dividends.

One further word about exposure. Having established the basic and bracketing exposures—usually half or two-thirds of a stop on either side of the basic—these should as far as possible be fixed for the entire production, and each scene lit to a standard value. This is undoubtedly of assistance in producing a smoothly flowing picture. The exposure given should generally be as low as is reasonable having regard to the lighting available.

Light Sources and Colour Temperatures.

A test film was made with photoflood lamps and was designed to try to elucidate the effect of variable voltages on the colour of the image. The details are as follows :—

Subject.—Miscellaneous well-known objects.

Lighting.—4 x 275 watt, 240-250 volt, photofloods in individual aluminium reflectors.

Voltage.—Varied by means of a Variac transformer.

Colour Temperature.—Measured by a Megatron meter directly at the lamps.

Exposure.—Measured by S.E.I. meter and brought to standard by adjusting the distance of the lamps from the subject. The colour temperatures due to voltage variation and the lens apertures, are shown in Table I.

The reason for the apparently high values for colour temperature is probably the use of newly-painted reflectors which have had a blueing effect. The values given, however, are comparable between themselves.

The film was then projected, and showed only negligible variation in colour balance between 180*v. and* 260*v. ; without direct side-by-side comparison it*

TABLE I

Colour Temperatures and Exposure Values on First Test

Voltage on lamps	°*K.* (*colour temp.*)	*Exposure at 24 f.p.s.*
180	3150	All at *f*/2
190	3300	
200	3400	
210	3420	
220	3500	
230	3550	
240	3650	
250	3750	
260	3850	
250		*f*/2
250		*f*/2.5
250		*f*/3.2
—		
230		*f*/2.
230		*f*/2.5
230		*f*/3.2
—		
210		*f*/2
210		*f*/2.5
210		*f*/3.2
260 (gradually dropped to extinction)		*f*/2

would have been difficult if not impossible to distinguish between the various takes. The difference in density between the various exposures in the second part of the film was such as might be expected. The last take in the film provided a complete fade-out to blackness, but very little degradation of colour was observed.

Small Influence of Colour Temperature.

The inference drawn as a result of these tests is that, as far as photoflood lighting is concerned, the influence of exposure variation is greater than that of variations of voltage and consequently of colour temperature. It is my opinion that unless gross differences in colour temperature are encountered, this factor is of considerably less importance than precision in exposure. Further, I have long held the view that of the factors contributing to colour balance in the final print, the effect of colour temperature of the light sources used is less than the combined effects of variations in the colour balance of stock, original and duplicating, and variations in processing, provided always that gross differences in colour temperatures are avoided, such as those due to change of type of light source, for example, arcs against incandescent lamps.

Nevertheless, there are occasions where, owing to large differences in colour temperatures of light sources, some control is important.

Choice of Filters.

Filters can be used for two purposes. It is important to keep these two uses quite distinct in the mind. First, they can be used to modify the characteristics of light sources, and second, they can be used to assist in correcting unwanted characteristics of the film itself.

Mention has already been made of slight variations in the colour characteristics of the stock. The extent of the variation will be revealed by tests on the lines outlined above, and if variation is detected which is considered undesirable, it becomes necessary to carry out further tests in order to decide what degree of colour correction is required. It will be noticed that the phrase "if a variation is detected which is considered undesirable" has been used. This is not intended in the slightest degree to be any reflection on the makers of the stock. Such variations as do from time to time occur are usually slight and can often be ignored, but it may happen that for precision work some correction is desired, for example, where it is desired to secure the very best rendition of a particular object or material. Sometimes the stock manufacturers recommend use of a filter for minor correction of colour balance, but if any filter is found to improve results in any particular batch as a result of one's own tests, it is a useful service to inform the manufacturers so as to make this information available to others.

The filters usually employed for such correction are the Kodak colour compensating series, CC23-24-25 (Yellow), CC33-34-35 (Magenta) and CC43-44-45 (Cyan), and, generally speaking, these will provide all the correction necessary or desirable. Here I would like to project another test reel, in which the effect of various filters was tried in a particular case. The details are as follows :—

Stock.—Regular Kodachrome.

Lighting.—700 foot-candles, white flame arcs, no filter on lamps. Colour temperature 5,100° K.

Filters and exposures.—As in Table II.

TABLE II

FILTERS AND EXPOSURE VALUES ON SECOND TEST

Test number	*Filter on lens*	*Exposure at* 24 *f.p.s.*
1	—	*f*/2.2
2	—	*f*/2.8
3	—	*f*/3.5
4	CC14	*f*/2.2
5	CC14	*f*/2.8
6	CC14	*f*/3.5
7	CC15	*f*/2.2
8	CC15	*f*/2.8
9	CC15	*f*/3.5
10	81	*f*/2.2
11	81	*f*/2.8
12	81	*f*/3.5
13	CC25	*f*/2.2
14	CC25	*f*/2.8
15	CC25	*f*/3.5

The film was then projected.

As a result of these tests it was decided to use a CC25 filter on the lens of the camera in the particular production in question.

Method of Use of Filters.

A further point may be made here, that great care must be exercised before deciding that a correction filter is necessary. The need should only be judged from a properly exposed test ; under-exposure will naturally tend to blueness, whilst over-exposure tends to redness.

Filters used for such a purpose are, of course, always used on the lens of the camera. Where, however, it is desired to introduce correction of the colour of the light sources, whether filters are used on the camera or on the lights themselves depends largely on the individual circumstances. If a scene is illuminated wholly by one type of source, for example, white flame arcs, of constant characteristics, the use of a filter on the lens gives satisfactory results.

Where the light sources vary, the lights themselves must be filtered individually to a common level. This may be time-consuming and expensive and, therefore, any sort of mixed lighting is to be avoided if at all possible. For use on lenses, the Kodak range of compensating filters, CC3-4-5-6 (blue) and CC13-14-15 (amber) are useful, but I have found that the CC20, 30 and 40 series mentioned above lead sometimes to a more pleasant screen result.

The only occasion when mixed lighting really becomes inevitable is where a large area is being photographed where daylight is present and cannot be excluded. In such a case, I have found that the use of white flame arcs filtered, using a CC23, CC24 or CC25 filter on the lens gives satisfactory results.

Let me emphasise, however, in all matters connected with colour balance the need for adequate tests. Tests enable the best light source-emulsion-filter combination to be arrived at, after which the use of a colour temperature meter assists in maintaining conditions constant.

Art Direction.

The important subject of Art Direction will now be briefly dealt with. Whenever possible, control should be exercised over the colour of objects and backgrounds. This is, of course, by no means always practicable, but it is often possible, even on industrial films, to have walls and machinery repainted in colours which are known to photograph well, so avoiding objectionable colour clashes and confusion which might otherwise result. Certainly the colour of garments, such as overalls to be used, can usually be influenced, and a further point is the need for complete co-operation and mutual understanding between all concerned in a colour production—from script to screen.

In editing a 16 mm. colour film, it is important to do all possible to ensure a smooth-flowing picture. Smooth flow is not only a matter of action continuity ; colour flow must be smooth as well. The eye should not be conscious of the cutting, and there is nothing more irritating than clashes of colour, contrast or density from scene to scene. This means not only careful direction and photography, but careful selection of the master takes to be used at the time of editing. It will be remembered that bracketing exposure has been recommended, primarily for the purpose of minimising processing variations. Such a practice has an added advantage, however, in that it makes the task of ensuring colour flow in the film easier to accomplish, since, although not primarily made for the purpose, one has more than one take from which to choose in selecting the masters to be used. In this way one is assisted in grading the film in cutting, and, although a certain degree of grading is possible in printing, this leads to a better screen result.

It is important that the laboratories should be given adequate time for their work. They too want to produce the best results, and any rush may mean quite unavoidably inferior work. This particularly applies to printing—if the job is hurried the benefit of all the careful work previously put into the film may be lost.

Sound Recording.

In regard to sound recording, the important thing is that the sound should be intelligible under the sort of conditions met with in average 16 mm. projection. These vary of course very widely, but it is probably true to say that in general the acoustics in the average hall where 16 mm. film is shown are poor compared with those of the average kinema. Further, as is well known, the response possible on 16 mm. film is inferior to that of 35 mm. film. The speech must " get through."

The sound track on a Kodachrome film is not a silver image, it is a sulphide image, brown in colour, and the contrast range is reduced compared with silver. Whilst it is normal practice to employ a " tipped-up " track for 16 mm. work, with Kodachrome the "tipping up" should be accentuated. I would not presume to make sound recording recommendations, but the view is held by some that an enhanced peak at about 5500-6000 c/s, followed by a sharp cut-off, with a gradual bass cut starting about 100 c/s, gives satisfactory results.[6]

In the compilation of this paper I have been greatly helped by three of my colleagues, Mr. George H. Sewell, Mr. P. W. Dennis, and Mr. Frank Cox.

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DISCUSSION

Mr. W. S. BLAND : Does Dr. Ward consider the colour temperature of the projection lamp equally immaterial ?

THE AUTHOR : I do not think the colour of the projection light is at all immaterial. Kodachrome is balanced for projection by filament lamps, and I always try to use at least a 750-watt lamp, and preferably a 1000-watt.

Mr. D. G. DAGGETT : Before using a batch of stock, how many feet of tests are shot ? Are they projected or viewed by hand ?

THE AUTHOR : We never shoot less than 100 ft., and we always view by projection.

Mr. SHARPLES : Has Dr. Ward encountered any special problems in dissolving one colour to another ?

Mr. P. W. DENNIS : If you have yellows or similar colours, your dissolve is apt to go wrong because they linger after other colours have disappeared.

Mr. H. S. HIND: In the case of a production 50% of which was to be daylight and 50% Type "A," which would Dr. Ward recommend: the use of two different batches, or daylight stock with filters for the interior shots ?

THE AUTHOR: I would prefer to use Type "A" film, assuming the interiors are going to be shot with photofloods ; a Wratten 85 filter would be used for daylight shots. If the interiors were going to be done with arcs, I should use Regular film throughout. I would in any case stick to one batch.

Mr. DEREK STEWART: Has Dr. Ward any experience of the use of bipost lamps in Fresnel type spotlights ?

THE AUTHOR : If the studio can be fitted with CP lamps, they will give good results. But if you are fitted with the ordinary studio lamps, there is a tendency to yellowness.

Mr. F. COX: Nearly all the work I have done recently has been with ordinary studio lamps. Dr. Ward's tests rather prove that the slightly lower colour temperature is not going to effect the colour balance of the film very much.

Mr. B. J. DAVIES : In regard to the choice of stock for a film to be shot half out-of-doors, the speed of Type "A" Kodachrome is 8 Weston, and of daylight stock 6 ; if you choose daylight emulsion, you get a speed of 6 in daylight, but with the daylight-to-tungsten filter the speed drops to about 2. With Type "A" emulsion, you start with 8, and in daylight the speed drops to 6. It is always advantageous to use Type "A" in such circumstances.

Mr. A. S. PRATT : If arcs are not acceptable for projection, what light is the projector manufacturer to use to give a brighter picture ?

Mr. HIND : The answer is to correct the arcs—but then the additional light is partly lost through the filter.

Mr. R. H. CRICKS: One must differentiate between the low-intensity and high-intensity arc; surely the light of the low-intensity arc is little different from that of the filament lamp ?

The following communication has been received from the Eastman Kodak Company of America:

It is our opinion that where 'Kodachrome' film is projected with an arc in a room where no ambient tungsten light is present, the picture quality is quite satisfactory. The eye will colour-adapt itself to the arc quality light, and not only in theory, but in practice, we find that the colour quality is satisfactory. If, however, there is tungsten light present in the room so as to furnish a reference to the eye, then undoubtedly the picture on the screen will look cold. Under these conditions for very critical viewing or possibly even with no ambient light present where the most critical viewing is desired, then it would be necessary either to filter the arc light to tungsten quality, or to make a special print in which the colour balance has been shifted in printing.

There is some variation in colour quality among individual prints in a release. This would indicate that there is some tolerance by the eye for colour quality, and in turn this would tend to indicate that the filter of the arc or shift in balance on the print would not need to be too precise to give satisfactory colour quality. We find in a number of places in the States that prints are used interchangeably on tungsten and arc projectors, and while the question has been raised academically, we have found no objection to the difference in quality between the two types of light sources.

ENGINEERING ASPECTS OF FILM PRODUCTION

R. Howard Cricks, F.B.K.S., F.R.P.S.

Abridgment of paper presented to the Manchester Association of Engineers on December 1, 1950. By courtesy of the Association, members of the B.K.S. Manchester Section were invited.

TO cover in a single paper the whole field of kinematograph engineering, or even of those sections of it pertaining to film production, would be obviously impossible. It is therefore proposed to confine this brief paper to the following aspects, arranged in descending order of magnitude :—

I. Production Equipment.
II. Camera Supports.
III. Cameras and Projectors.
IV. Problems of Picture Steadiness.

I—PRODUCTION EQUIPMENT.

It is perhaps illogical to start with this subject, since until comparatively recently tradition rather than engineering was its basis. Sets are still built in much the same way as in the theatre, except that tubular scaffolding replaces wood. Overhead lights are in the majority of cases still mounted on gantries or " spot rails " built up around the scenery, or on " parallels " suspended from roof trusses.

In a recent film production, the revolving stage, as used in the theatre, found an application. In that outstanding British film, " A Matter of Life and Death," the stairway which led from the celestial regions down to earth was actually a full-sized escalator. Another film in which precision engineering was employed in set construction was " Rope." In order that the camera might move through doors and walls, whole sections of the set were built on hoists and slides ; as the camera moved forward and the door frame passed out of the picture, the section of wall slid away, allowing the camera to pass into the adjoining room.[1]

For any outstanding developments in production equipment we have to thank the " Independent Frame " process.[2] This system calls for a factory-like organisation of the studio. Sets are built on wheeled rostrums, in a construction department which may be a considerable distance from the stage ; they are wheeled through a set-dressing department, and then into a waiting bay until they are needed for production.

From here they progress as required to the studio floor, where they are positioned by means of a grid marked out on the floor. When the set is positioned, lights and cameras are mechanically moved into place. After shooting, the sets are wheeled into another department for dismantling.

Mobile Gantries and Screen Frames.

Instead of the usual wood gantries and parallels, lights and other equipment are carried on mobile gantries. A large part of the equipment is " flown " from gantries which are, in effect, travelling cranes, suspended from the roof trusses. Other gantries run on the floor on rubber-tyred wheels ; each is capable of accommodating perhaps a dozen lamps and two electricians, and is movable in any direction, and adjustable for height, by means of press-button controls. Another similar piece of equipment is the screen frame. Both these pieces of equipment were built by Vickers-Armstrong, and embody the " stressed skin " principle used in seaplane construction.

Mention should be made of a simple piece of equipment, the " Spelleroller," which enables one or two men to lift a heavy piece of scenery and wheel it about with ease.[3]

II—CAMERA SUPPORTS.

In the early days of the sound film, the camera was rendered immobile by the requirements of the microphone, and was often placed inside a sound-proofed booth. To-day the camera is required to be freely mobile in every direction. Flexibility of camera movement is made more difficult by the increasing weight of cameras—colour cameras in particular. The Technicolor camera, for instance, in its sound-proof blimp, weighs no less than 640 lb.

The most popular form of camera support is known for some inscrutable reason as the " dolly." A more elaborate device is the camera crane ; cranes range in size from a type small enough to pass through a standard doorway, up to massive structures, capable of lifting the camera and its crew 20 feet or 30 feet into the air.

Where the camera is required to track during shooting, temporary rails of wood, or preferably duralumin, are laid. In a recent French film, the whole of the first reel was occupied by a single tracking shot, for which 200 feet of rails were laid.

Recording Camera Movement.

To appreciate the value of modern developments in camera control, it is necessary to picture the sequence of operations in shooting a scene. The camera positions and movements will be laid down approximately in the shooting script ; during rehearsal they will gradually become finalised, and must then be repeated with as close accuracy as possible.

A system has therefore been devised whereby a record of the movements of the camera in three directions, together with a record of the focal adjustments of the lens, is recorded during rehearsal, in the form of tracks of variable frequency upon a gramophone disc ; this is reproduced during shooting, and controls every movement of the camera, ensuring accurate repetition of camera movement.[4] While the device described is of American origin, a similar system is in experimental use in a British studio.

Travelling Matte Process.

An objection to the use of such systems is that actors cannot be controlled by similar automatic means, and frequently ruin a take by stepping outside their limits. There is, however, one type of shot to which this does not apply, and which indeed is rendered possible only by some automatic control of this type.

An example of such a shot might be a model in which live action is required. In one method of producing such an effect, the model is filmed, leaving a blank space where the action is to appear. The small full-scale set where the action is to take place is built in the studio. The camera is threaded with two films : a print from the first film, in front of negative stock. The image on the front or matte film prints through, and the final negative consists of an image of the model, and in the blank space the photograph of the action. This is known as the travelling matte process.

Effects of this nature have in the past been possible only with a stationary camera, because obviously any camera movement in the filming of the model shot must be exactly duplicated in the filming of the live action. But with the aid of an automatic method of ensuring exact repetition of camera movement, it is possible for movement to be exactly repeated, and the camera thus regains its mobility.

III—CAMERAS AND PROJECTORS.

Every camera and projector—and indeed most other film equipment—embodies the same essentials as were devised by William Friese-Greene[5] sixty years ago : a take-off reel, a continuous feed sprocket feeding the film through a loop into the gate, within which it is moved intermittently, a second loop feeding it to the second continuous or hold-back sprocket, and thence to the frictionally driven take-up reel. The movement of the film is obturated by means of a rotating shutter.

Stroboscopic Effect.

The obturating shutter is, of course, the cause of a phenomenon frequently seen even in feature pictures : the effect of wheels or other moving objects appearing to stand still or move backwards. The illusion will be familiar to every engineer as an example of the stroboscopic effect.

The relation between film speed and wheel speed may be expressed by the equation :—

$$\frac{nR}{F} = p$$

where n = the number of spokes, R = speed of the wheel (revolutions per second) and F = speed of film (frames per second). Assuming a shutter opening of 180 degrees, it can be said that :—

- when $p < \frac{1}{3}$, movement will appear correct ;
- when $p = \frac{1}{2}$, two sets of stationary spokes will appear ;
- when $p = 1$, the spokes will appear stationary ;
- and generally when $p = \frac{1}{4}$, $\frac{1}{2}$, or any low whole number, there will be some fault in the appearance of the spokes. The precise values and the degree of fault will depend upon the exact shutter opening, and upon such factors as the width of the spokes and the type of lighting.

While it would be a very simple matter to make such a calculation prior to the shooting of a scene, actually the focusing system making use of a mirrored shutter permits stroboscopic faults to be observed and avoided. It may, for instance, be possible to alter the speed of the vehicle, or even of the film ; failing either, the vehicle may be fitted with different wheels.

The High-speed Camera.

A particular form of camera which finds many applications is the high-speed camera, which, of course, produces the illusion of retarded motion, and is, therefore, often known as a slow-motion camera (the German term *Zeitlupe*, or time magnifier, is particularly apt).[6] Although for scientific purposes cameras operating at fantastic speeds up to 100,000,000 images per second have been devised, so far as normal film production is concerned, speeds are rarely needed above 250 frames per second—about ten times normal—and cameras capable of such speeds are of similar type to those just described, with the intermittently moving components lightened for ease of running.

While the use of slow-motion photography is quite familiar in news-reels, it may be a cause for surprise that it should find much application in the studio. Its chief application is in model shots. The rate at which a model falls, or the movement of artificially produced waves, will be out of proportion to the scale of a model. The movement is slowed down by the use of the high-speed camera.

Whenever a model falls freely a ratio is immediately established between the rate of fall of the model and the rate of fall of the supposedly full-size object, and in theory the reduction in speed should be proportional to the square root of the scale of the model. It must, however, be admitted that experience is more often used than mathematics to determine camera speed.

Process Projection.

There are many arguments in favour of bringing the exterior scene into the studio—not the least the uncertainty of British weather. The most widely used method is known as process projection. As far back as 1932, this process reached a high state of perfection in the film " Rome Express." For recent developments, much credit must be given to the Independent Frame process above-mentioned.

For this process equipment of very special design has been evolved. The arc lamp is capable of carrying currents up to 300 ampères ; through an optical system of novel design, its light is condensed upon the film or transparency, which is cooled both by air and water.[7] The objective lens is movable by remote control laterally, vertically, and, for focusing, longitudinally ; the object of remote control is to enable the picture to be focused and positioned on the screen by an operator standing near the camera, and able therefore to match the background with the already positioned foreground set. The moving background projector is arranged to run forwards or backwards, so that at the end of a take the film can be wound back, ready for the next take.[8]

IV—PROBLEMS OF PICTURE STEADINESS.

Ultimately, the acceptance by the viewer of the illusion of reality depends upon the steadiness of the projected image, and upon its critical sharpness of focus.

In order to achieve an adequate standard of steadiness, it is essential that

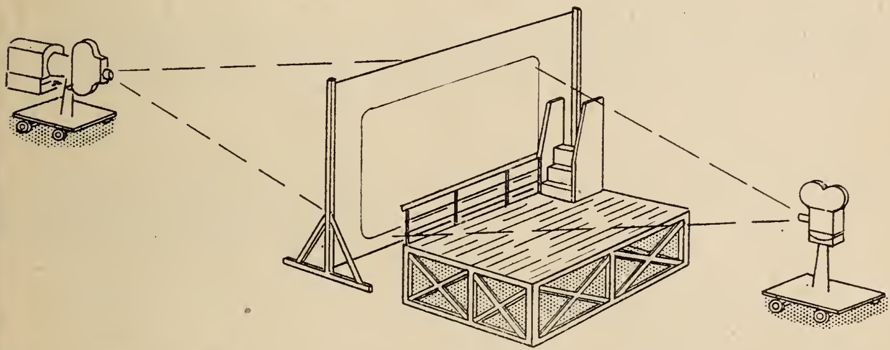

Fig. 1. Principle of Process Projection. The projector is to the left, and the camera on the right photographs the foreground set with the image projected upon the translucent screen.

the accuracy of registration of the image—*not* merely of the film itself—in the projector gate should be of the order of two to three mils ; an error of this order is equivalent to a picture movement on the screen of from a quarter of an inch to one inch. With the wide-aperture lenses now used, both in cameras and projectors, the film must not depart by more than one or two mils from the focal plane of the lens.

Summation of Errors.

These tolerances represent the summation of a number of possible errors. From the negative a master positive or " lavender," is printed, and from this a dupe negative from which the release prints are produced. The travelling matte and back-projection processes just described are in effect duping processes, in which, however, the standard of steadiness is even higher than that in other processes, because of the noticeable effect of background unsteadiness in relation to a steady foreground. In addition, the making of " opticals " introduces for part of the footage yet another duping operation.

It will be seen that from the original photography to the projection of the film in the kinema, there is a sequence of at least four, and more often six or eight, films. Our permissible error of two or three mils represents, therefore, the summation of errors in the perforation of this number of films, and in the registration of the several films in cameras, printers, and projectors.

Instability of Film.

Such a degree of accuracy would be far from easy of attainment if we were dealing with a comparatively rigid unvarying substance such as steel. But apart from the low tensile strength of film as compared with metals, both base and emulsion are exceedingly hygroscopic, and vary considerably in dimension according to the humidity.[9] Furthermore, the different characteristics of the base and emulsion cause the film to behave in the manner of a bi-metal strip, resulting often in an inherent buckle. Yet another complication is that in the manufacture of film stock, those strips near the edges of the wide roll are apt to have a lateral curl or " weave."

Either buckle or weave is capable of displacing the film from the focal plane of the optical system, or in the case of a contact printer, out of contact with the second film, so causing loss of critical sharpness. In the majority of devices, other than certain of those to be later described, the film is kept flat in the gate simply by spring pressure on the four margins of the picture, aided in the case of contact printers by the use of a curved gate, which naturally prevents lateral buckle.

Intermittent Motion Devices.

Earlier cameras and printers made use of simple feeding claws ; in these mechanisms, as in the Maltese cross system, the film is braked frictionally, and

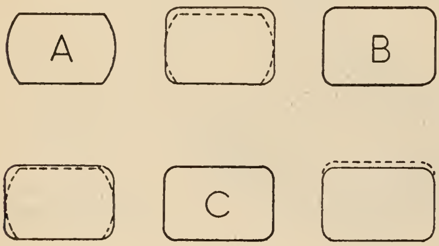

Fig. 2. Comparison of film perforations. A, negative; B, positive ; C, proposed combination type.

is guided laterally by its edges.[10] To attain a higher standard of accuracy, the film must be controlled solely by its perforations ; it must be under positive control during the whole period of movement and exposure ; and the registering means must be close to the picture aperture, in order that variations in the pitch of perforations shall have the least effect upon film registration. Consequently, feeding claws are now supplemented by register pins.

One objection to such a mechanism is that the moving register pins must necessarily have some working tolerance in their guides, which may lead to slight unsteadiness. Furthermore, the register pins must obviously be a good fit in the film perforations ; if they are slightly too tight, their movement—part of which takes place during the exposure period—may cause the film to move slightly out of the focal plane, an effect known as " breathing." These defects are for many applications endured, because motions of this type can be constructed to operate very silently.[11]

However, it is better engineering practice to provide stationary register pins. The first intermittent motion device which embodied such a feature was designed by an engineer to whom the industry owes much, the late Arthur S. Newman. A device of similar principle is to-day widely used in all types of apparatus where noise is of no consequence. In both these mechanisms, the film is guided in a lifting gate, which lifts it to engage with the feeding claws, and during exposure clamps it upon the pressure pad and in engagement with the fixed register pins.

Since film is a dimensionally unstable material, and its liability to shrinkage is particularly marked in the lateral direction, it is the general practice to arrange for one register pin to fit the perforation in both directions, and the second pin to fit only vertically.

Perforation Standards.

Since the film perforations play such an important part in ensuring steadiness of the projected picture, one would have thought that their form and dimensions would have been closely standardised. Strange to say, two different forms of perforations are in current use, and a third is projected. That known as the negative perforation (A in Fig. 2) is based upon the original design of Edison, while the positive perforation B, designed by Kodak, is rectangular with radiused corners. Any hope of interchangeability in a register-pin mechanism is negatived by the fact that the former is 0.006 inch higher than the latter. Thus, all negative stocks and laboratory films are made with the original negative perforation, whilst positive release films—which are printed in a continuous machine in which the films are driven by a continuously rotating sprocket—have the rectangular perforation, which provides greater resistance to wear.

The proposed third perforation form, known as the Howell & Dubray (C in Fig. 2), is an attempt to reconcile the differences between the two earlier types of perforation.[12] The reduced height as compared with the original positive perforation is made possible by the lower shrinkage of modern film stocks. It is not yet an accepted standard.

Wear-resisting Requirements.

Film has a considerable abrasive action upon even the hardest of metals. In the case of the kinema projector this is hardly surprising, seeing that in an average day's programme well over half a million frames of film will be projected. Even in the studio camera exposing only a few hundred feet of film a day, the effect cannot be neglected.

Monel metal, hard grades of stainless steel, and hard chromium plating, are commonly used for parts subject to film wear, notably the gate components.[13] Experiments are now in hand in the use of synthetic sapphire inserts for such components—a principle which Newman introduced many years ago.[14]

A factor which may have undesirable effects is that new film stock has a slight excess of free acid, which in course of time etches polished surfaces ; on polished pressure pads, for example, the shape of the perforations of the temporarily stationary film becomes visible. Yet another factor associated especially with high-speed cameras is the discharge of static electricity from the rapidly moving film ; it has been found that Monel is particularly resistant to pitting.

CONCLUSION.

It has been possible in this brief paper to deal only superficially with a very small proportion of the field of kinematograph engineering. The aspects chosen have been those most likely to be of practical interest to those engaged in other branches of engineering.

One final point should be stressed. Ten years ago, most of the equipment in British studios was of American origin. To-day, the bulk of studio equipment, and almost the whole of kinema equipment, is British ; all the equipment here described is of British construction, and, with one or two exceptions, of British design. It is particularly gratifying that this country, which, American claims notwithstanding, can be credited with the invention of kinematography, should now be producing equipment at least the equal of, and in some respects superior to any in the world.

By courtesy of Mr. G. Wynne, of the C.W.S. Film Section, Manchester, a Newall camera and G.E.C. lighting equipment were demonstrated by Mr. H. S. Hampson.

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TECHNICAL ABSTRACTS

Most of the periodicals here abstracted may be seen in the Society's Library

COLOUR DEVELOPMENT IN THE PRESENCE OF COLOURED COUPLERS

R. Merckx, *Science et Ind. Phot.*, Mar. 1950, p. 84.

Fourteen new dyes have been examined in colour development with NN_1-diethyl-p-phenylene-diamine. The presence of a nitrile group attached to the C in the chain $=C=N-$ appears to be essential for the formation of an azomethine dye. G. I. P. L.

OBTAINING COLOURED PHOTOGRAPHIC IMAGES BY ELECTROLYSIS OR ELECTRO-SYNTHESIS

J. Rzymbowski, *Science et Ind. Phot.*, Mar. 1950, p. 86.

The cathodic reduction of a mixture of phenol with nitrothymol or nitrocresol gives the reduced form of an indophenol which constitutes the developer. In development the insoluble oxidised form of the indophenol is deposited with the silver image and remains as an intense blue dye image when the silver is removed.

G. I. P. L.

CATADIOPTRIC OBJECTIVES

M. Paul, *Science et Ind. Phot.*, Mar. 1950, p. 81.

A review is given of catadioptric, i.e. reflection-refraction, objectives such as the Schmidt system. G. I. P. L.

A NEW *f*/1.5 LENS FOR PROFESSIONAL 16-MM. PROJECTION

W. E. Shade, *J. Soc. Mot. Pic. and Telev. Eng.*, Mar. 1950, p. 337.

The historical development of Petzval type projection lenses, incorporating a field flattening element near the focal plane, is outlined. The progressive improvements in aberration correction and performance are described, comparative data being given for a new series of *f*/1.5 lenses of this type announced by the Eastman Kodak Co. Improvements in resolving power, contrast and back focus are claimed. A. H. A.

A MOTION REPEATING SYSTEM FOR SPECIAL EFFECT PHOTOGRAPHY

O. L. Dupy, *J. Soc. Mot. Pic. and Telev. Eng.*, Mar. 1950, p. 290.

Tilting and panning movements of a camera head are recorded in the form of tracks on a disc. To reproduce the movements, the amplified signals are caused to operate a differential drive system controlling the camera movement. R. H. C.

INCREASED NOISE REDUCTION BY DELAY NETWORKS

J. Soc. Mot. Pic. and Telev. Eng., Mar. 1950, p. 295.

The signal applied to the modulator of a photographic sound recorder is delayed with respect to that applied to the noise reduction circuit. This is accomplished by means of a series of four delay networks, giving a total of 14 milliseconds delay over a wide frequency range with very low distortion. With this set-up, margin setting may be reduced to zero, and noise reduction values as high as 30 db obtained without audible distortion.

N. L.


EASTMAN
POSITIVE
NITRATE MOTION PICTURE FILM
1½ in. Fine Grain 35 mm.
RELEASE
KODAK LIMITED, LONDON
2 ROLLS
EASTMAN
POSITIVE
MOTION PICTURE SAFETY FILM
Fine Grain
RELEASE
SAFETY
CODE 7302
KODAK LIMITED, LONDON
'KODAK' Film - the natural choice

MINIATURE CONDENSER MICROPHONE

J. Soc. Mot. Pic. and Telev. Eng., Mar. 1950, p. 303.

The microphone comprises a transducer of 0.6 in. diameter, coupled to a miniature valve working as a cathode follower. This unit is connected by cable to a supply unit containing amplifier components and power pack. Radial response curves and constructional details are given. N. L.

SUPPLEMENTARY MAGNETIC FACILITIES FOR PHOTOGRAPHIC SOUND SYSTEMS

J. Soc. Mot. Pic. and Telev. Eng., Mar. 1950, p. 315.

Facilities designed for converting to magnetic operation several types of Western Electric equipment are described, including both photographic recording and re-recording machines. Photographic operation may be retained with the magnetic adaption in position if desired. N. L.

SPROCKETLESS SYNCHRONOUS MAGNETIC TAPE

J. Soc. Mot. Pic. and Telev. Eng., Mar. 1950, p. 328

The tape recorder uses standard ¼-inch unperforated tape on which, in addition to the longitudinal recording of the signal, a transverse recording of a 60 c/s synchronising tone is recorded. In reproduction or re-recording, the synchronising tone may be used to control motor speed. N. L.

ADJUSTMENTS FOR OBTAINING OPTIMUM PERFORMANCE IN MAGNETIC RECORDING

Albert W. Friend, *RCA Review*, Mar. 1950.

Response curves obtained with " Scotch " magnetic tape demonstrate how the second harmonic can be avoided by carefully adjusting a direct current in the recording head by means of a so-called harmonic-null potentiometer. The choice of suitable bias in order to obtain the minimum of third harmonic and the maximum of sensitivity is also described. Finally, the author concludes that the simplest method of obtaining the harmonic null adjustment referred to is aurally, especially as most amplifiers produce a certain amount of residual hum ; the adjustment is then made to the minimum of noise, which is equivalent to the minimum of second harmonic distortion. O. K. K.

A PRESERVATION RECTIFIER WITH ELECTRONICALLY STABILIZED CHARGING VOLTAGE

E. Cassee, *Philips Tech. Rev.*, Mar. 1950, p. 253.

In a battery charging rectifier, the battery voltage is amplified to provide control current to a transductor. Consistency of charging voltage to within $\pm 0.5\%$ is attained. R. H. C.

THE LABORATORY TECHNICIAN

The Editor,
" British Kinematography."

Dear Sir,

Dr. Levenson's review of Lobel and Dubois in the October number of *British Kinematography* raises a question on which there may well be differences of opinion. In my view " intermediate grounding in physics and algebra " is not only an advantage but a necessity for those who work in sensitometry, or indeed in any technological branch of kinematography.

A case may be made out for photographers who know nothing or care less about photography, or for script writers who have not even an intermediate grounding in the English language, but a laboratory technician who has not a fundamental knowledge of the tools with which his technique is operated is nothing but a labourer, and such he should remain unless he studies the rudiments of mathematics and physics as such, and not as mere tricks by which sensitometry can be made easier.

Therefore I say, when Jones' " Photographic Sensitometry " is reprinted, leave out the " introductory section " and send the readers to school.

I am, Sir, Yours faithfully,

J. L. French.

THE COUNCIL

Summary of meeting held on Wednesday, November 1, 1950.

Present : Mr. A. W. Watkins (*President*) in the Chair, and Messrs. L. Knopp (*Vice-President*), E. Oram (*Deputy Vice-President*), H. S. Hind (*Treasurer*), F. G. Gunn, B. Honri, T. W. Howard, N. Leevers, S. A. Stevens, R. J. T. Brown (*representing Papers Sub-Committee*) and W. A. J. Matheson (*Auditor*).

In attendance : Miss J. Poynton (*Secretary*).

Apologies for Absence.—Apologies for absence were received from Messrs. W. M. Harcourt, R. Pulman, and I. D. Wratten.

Gift to the Society.—Two cameras of historical interest had been presented to the Society by Mr. J. S. Abbott. Details would be published in the *Journal*.

Television.—The Council of the Television Society had given preliminary consideration to the proposals reported last month. It appeared that the details would need careful study, and the suggestion was made that the whole question should be the subject of consideration by a Committee representative of both the Societies. Messrs. L. Knopp and S. A. Stevens were appointed the representatives of the British Kinematograph Society.

Forthcoming Events.—Arrangements were put in hand for two events to take place in 1951. The Film Production Division would organize a visit to either Alexandra Palace or Lime Grove Studios, and the Theatre Division would organize a visit to the Festival of Britain Telekinema. Both visits, which would be open to all members of the Society, would take place in April or May, on a Saturday and Sunday respectively, though not in the same week-end.

Education Committee.—The successful launching of the course on Lighting for Kinematography was considered by the President as being a matter for congratulation. Tribute was paid to Mr. Baynham Honri for his work. A course on Sensitometry would commence in February, 1951.

The proceedings then terminated.

BOOK REVIEWS

Books reviewed may be seen in the Society's Library.

DAS GROSSE FILM- UND KINO-ADRESSBUCH, 1950/51. *Neue Verlags-Gesellschaft m.b.H., Baden-Baden, DM.*30.

The German " Das grosse Film- und Kino-Adressbuch, 1950/51 " has just come to hand and is a voluminous production containing a large number of names and addresses of importance concerning the German film industry. In addition, it contains a complete list of all the German kinemas including those in the Eastern (Russian) zone. There is also a " Who's Who " and a brief survey of the state of the film industry in the different foreign countries. No technical matters are mentioned but it is a useful reference book, particularly for film renters and exhibitors.

O. K. KOLB.

TRIO. Three Stories by W. Somerset Maugham. Screen adaptations by W. Somerset Maugham, R. C. Sherriff and Noel Langley. Heinemann, 7s. 6d.

It is interesting to compare the three original stories by W. Somerset Maugham with the screen plays as written for " Trio." Somerset Maugham is undoubtedly one of the greatest descriptive writers of the present day. In the visual presentation of his works this descriptive art is lost, and although the results still bear traces of the sharp dry humour of the author, there is lacking the very essence of the Maugham style. There have also been many slight alterations in the screen adaptations, in addition to the loss of descriptive style, which tend to make the admirer of the original Maugham prose very irritable.

Maugham has written eighteen plays altogether. If the film producer wishes to pay tribute to this author's work, these plays, which rely mainly on dialogue, are infinitely more suited to screen adaptation than his stories. Let it be hoped that in future, long or short stories, by authors famed for descriptive writing will not be mutilated for screen presentation. A.R.R.

PERSONAL NEWS of MEMBERS

Members are urged to keep their fellow members conversant with their activities through the medium of British Kinematography.

H. K. BOURNE is leaving Mole-Richardson, Ltd., at the end of January to take up a position as a Scientific Officer at H.M. Torpedo Experimental Establishment, Greenock.

D. CHATTERJEE has been directing Vabani Kalamandir's social film " Maryada," which will be released in Calcutta shortly.

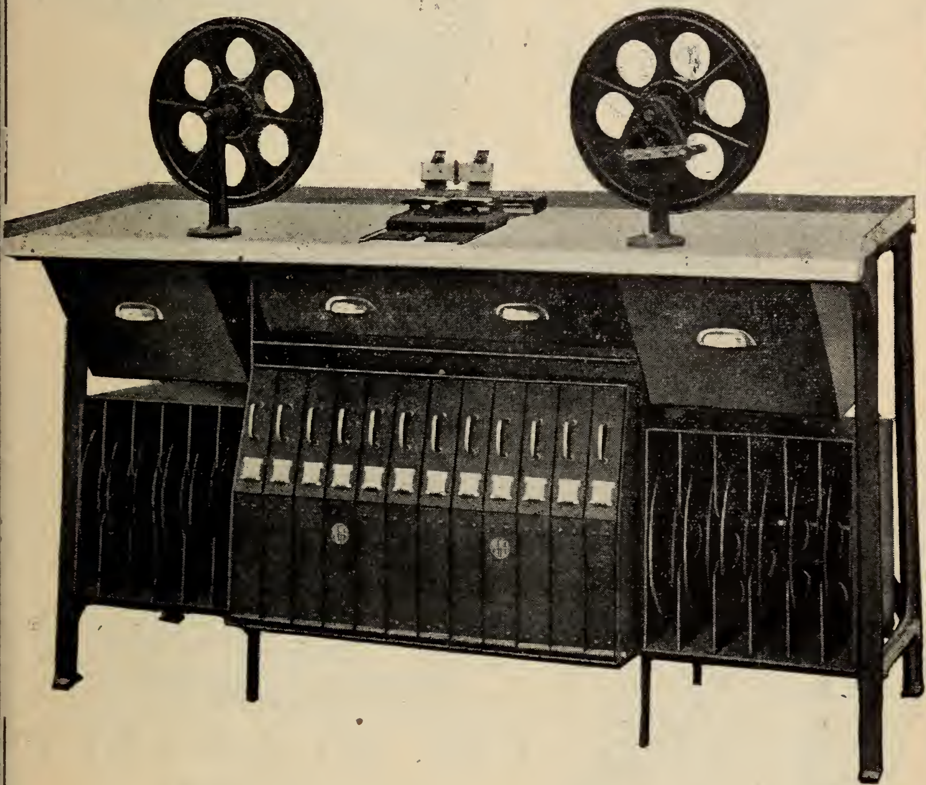
LOUIS MANNIX has now returned to duty after his recent illness.

E. ORAM has left Barnet-Ensign-Ross, Ltd.

A. W. WATKINS has left King's College Hospital, and is now convalescing for a month.

PREMIER

DE LUXE REWIND BENCH



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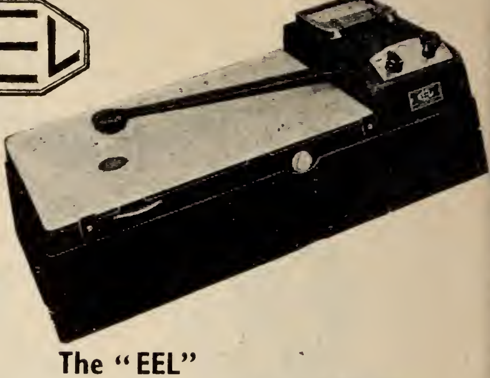

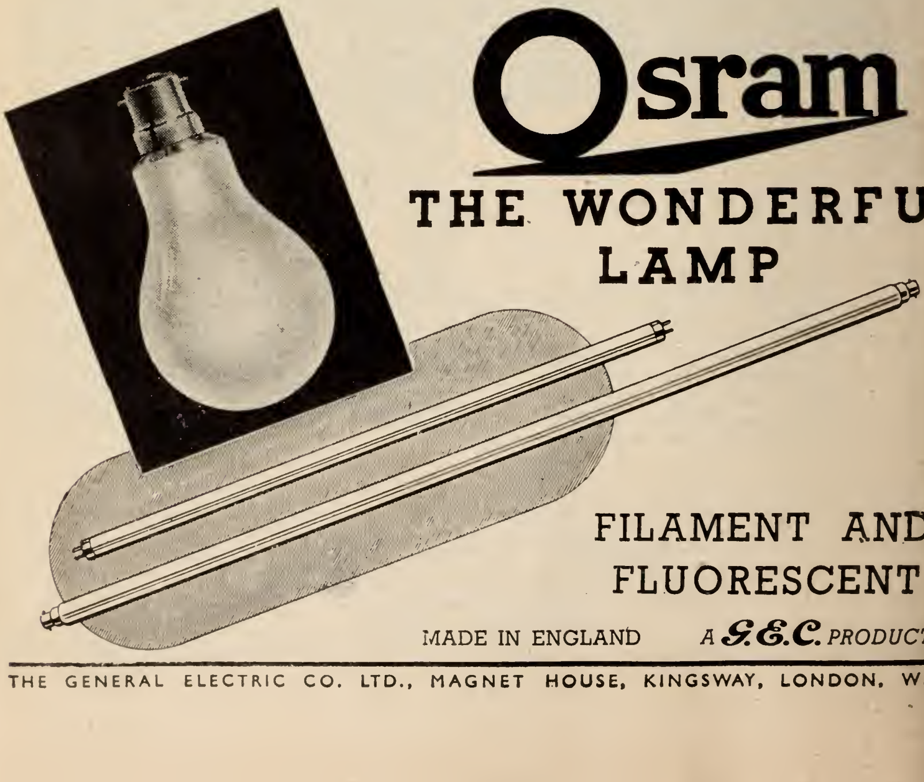

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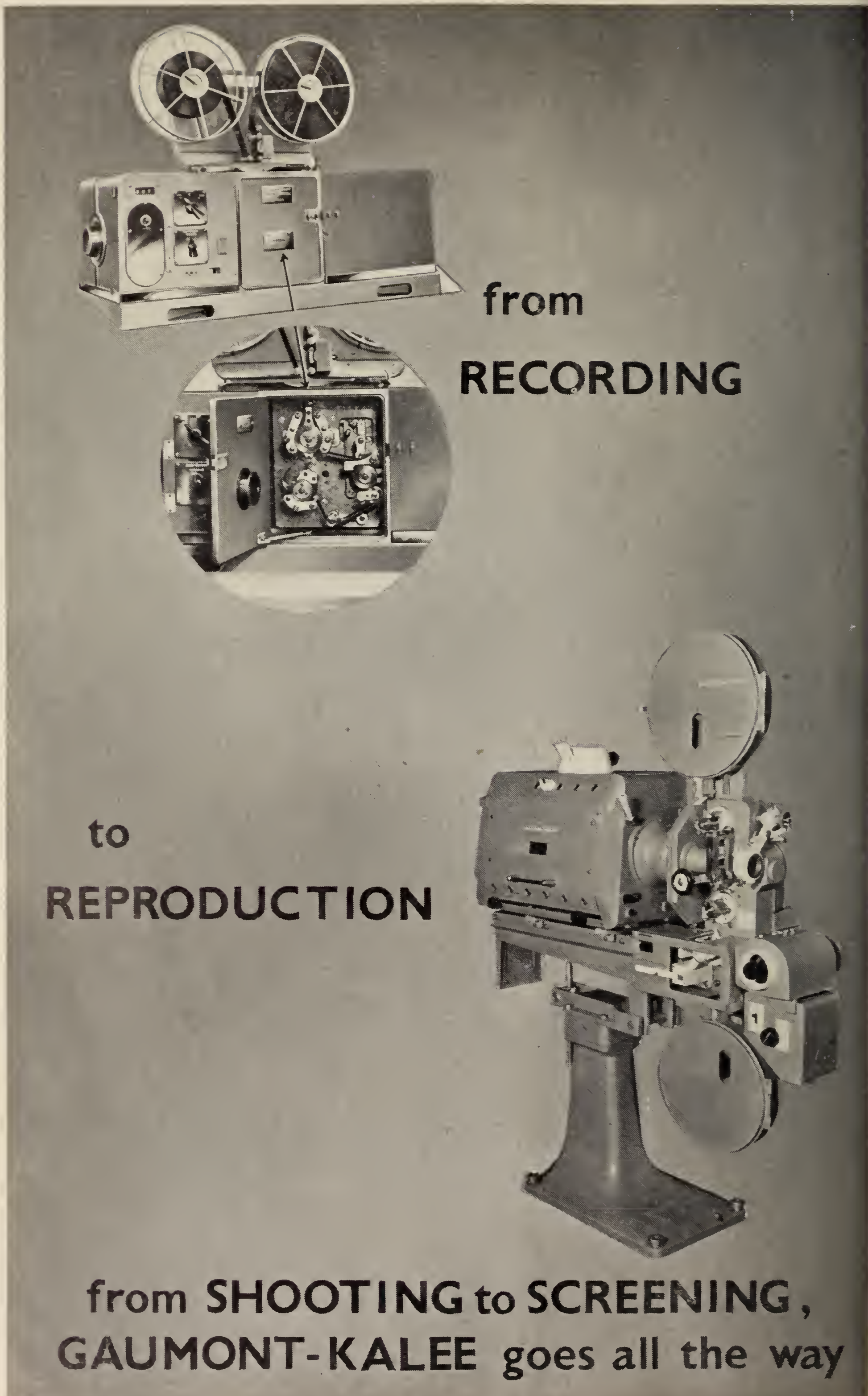
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